THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXXXVI. No. 2145.] LONDON, JUNE 21, 1904. [56TH YEAR. PRICE 6d.

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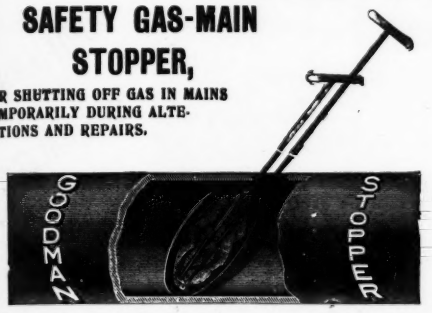

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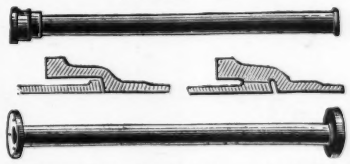

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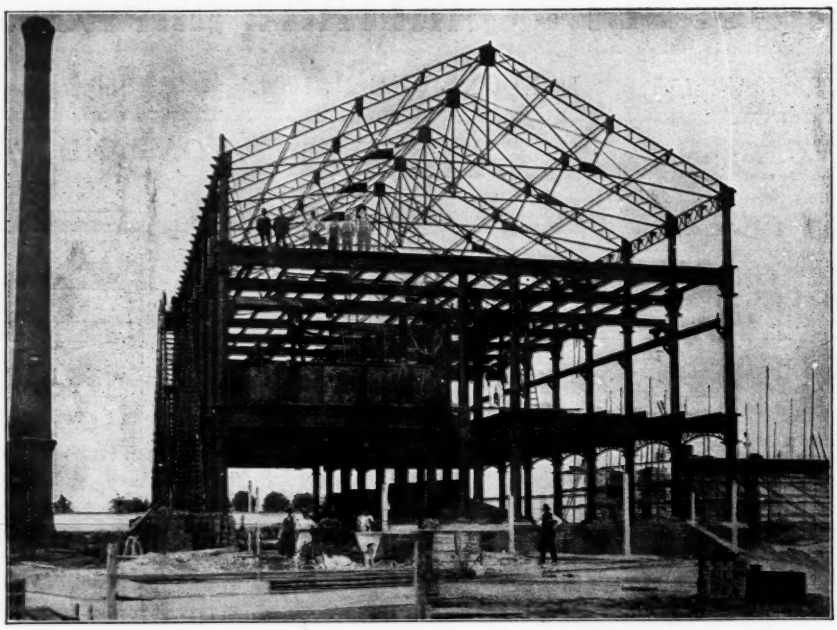

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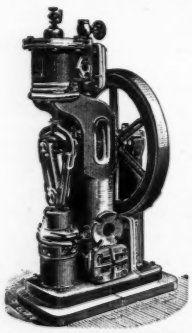

Fig. 705. "SINGLE RAM" STEAM-PUMP.

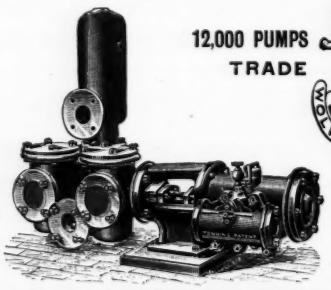

Fig. 598. "CORNISH" STEAM-PUMP FOR BOILER FEEDING, &c.

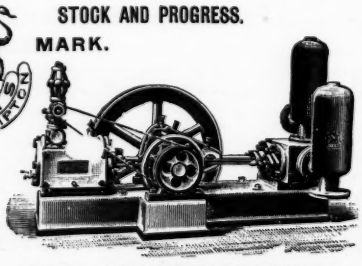

Fig. 685. "RELIABLE" STEAM-PUMP FOR TAR AND THICK FLUIDS.

Fig. 712. "DOUBLE-RAM" STEAM-PUMP.

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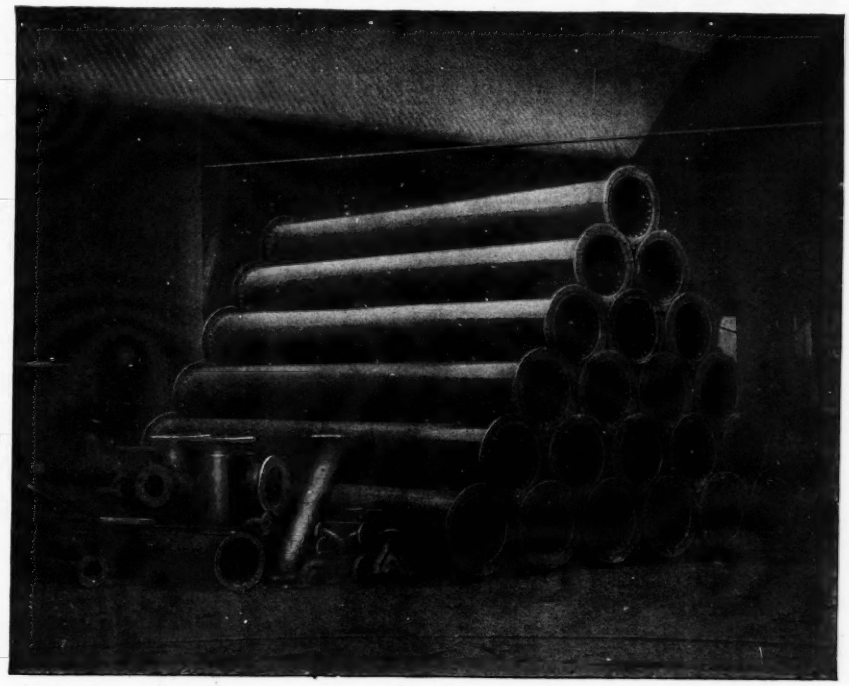

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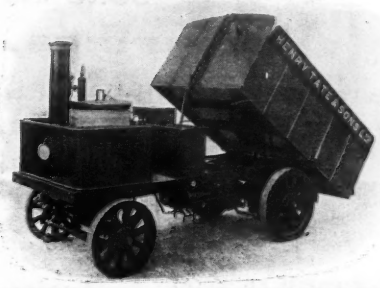

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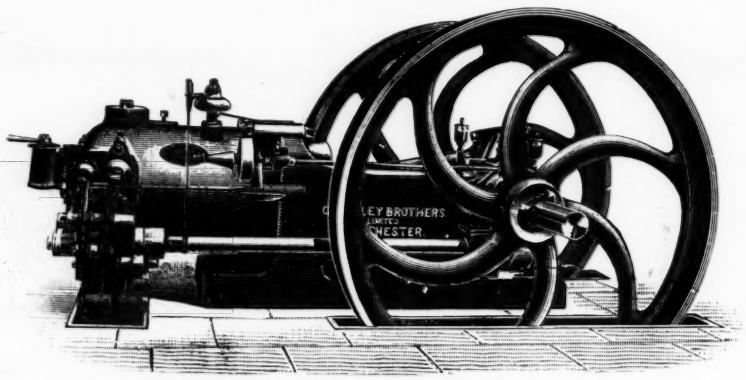

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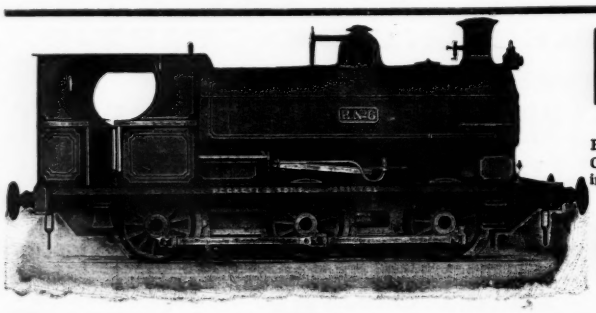

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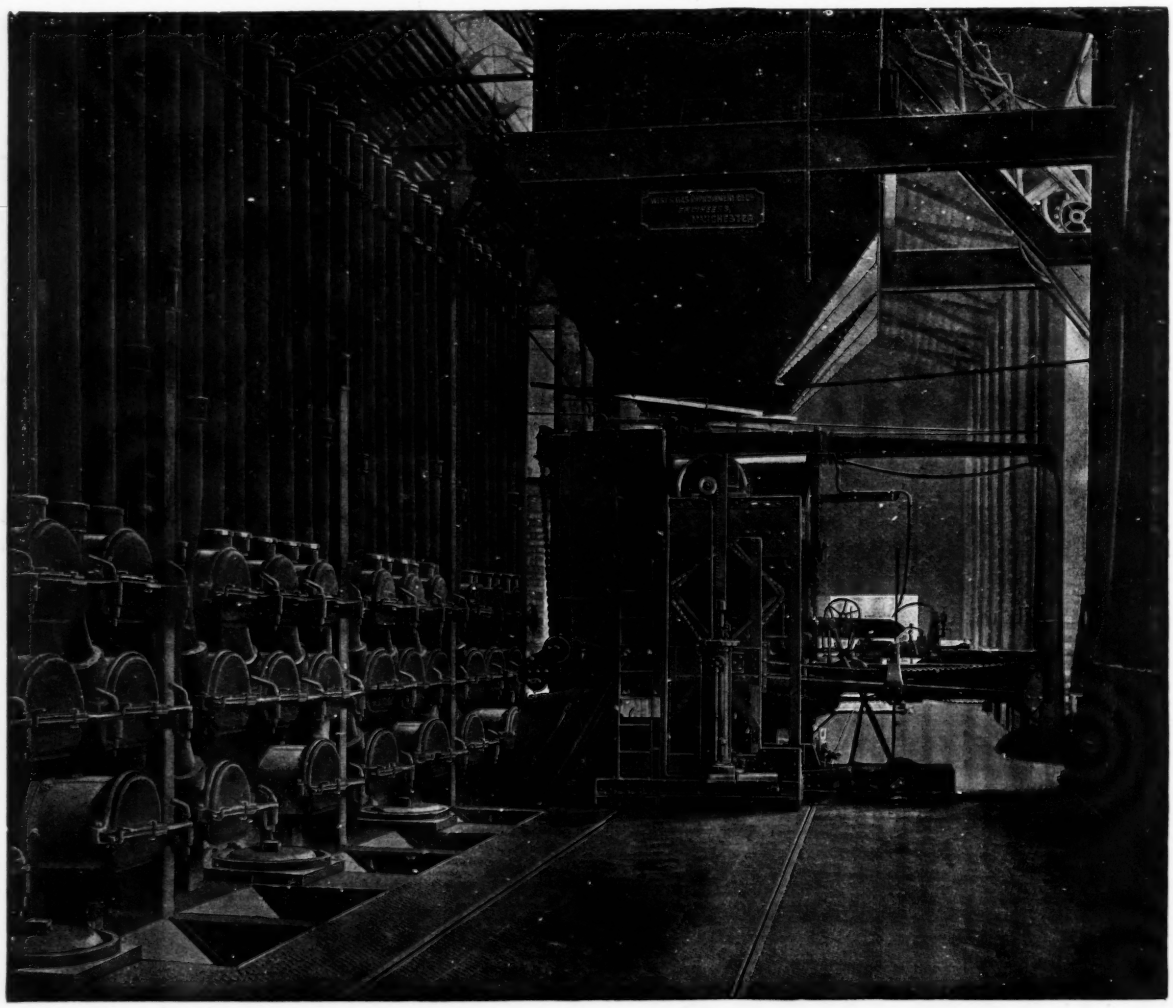

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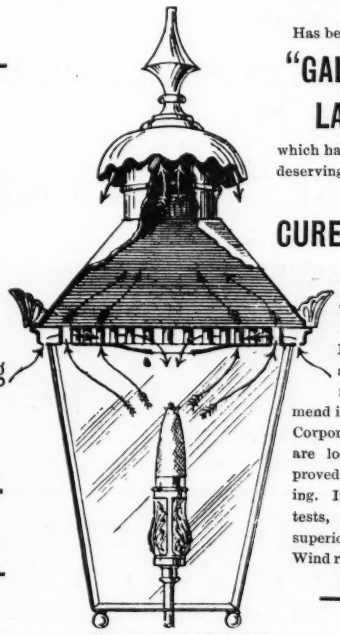

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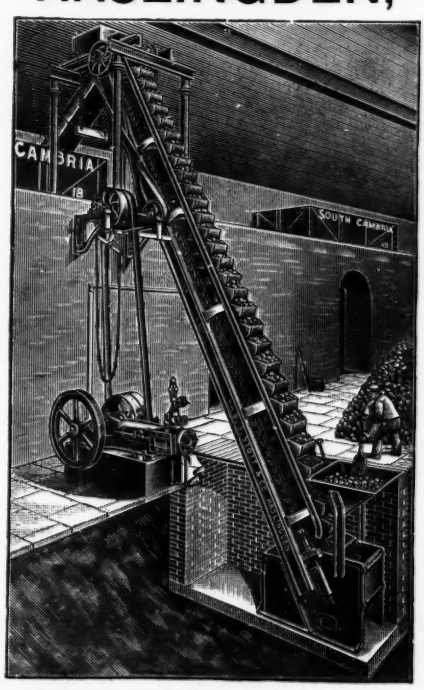

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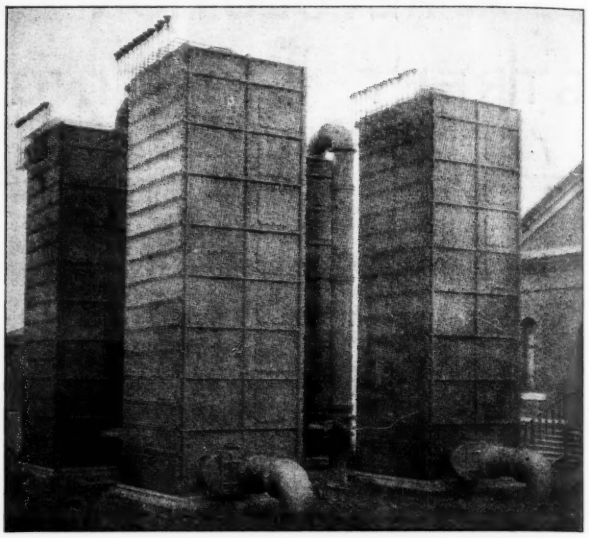

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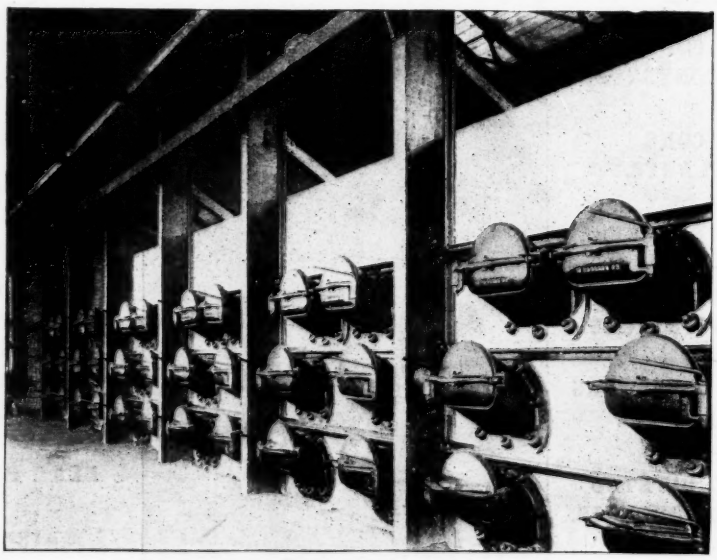

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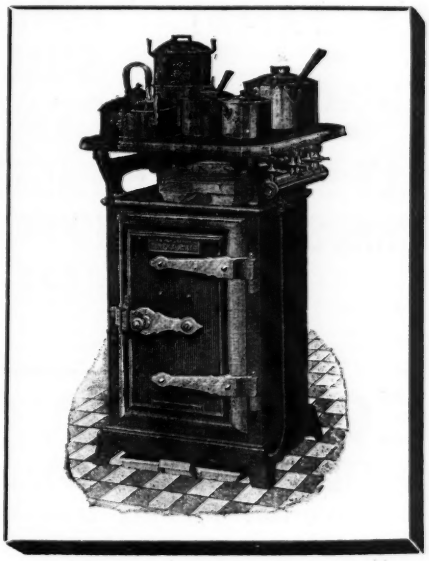

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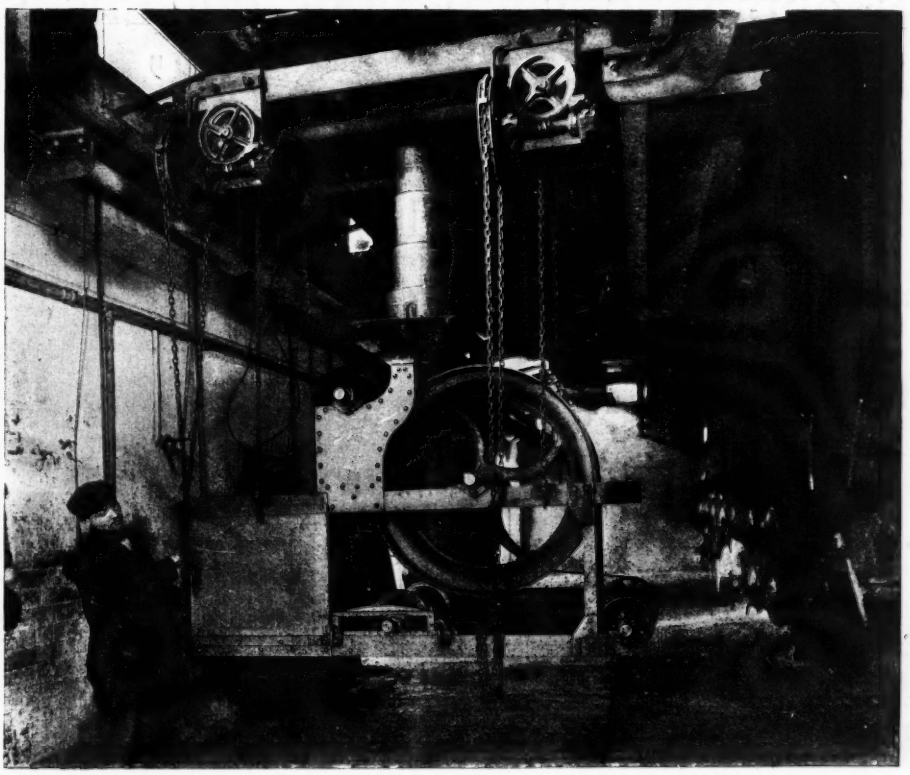

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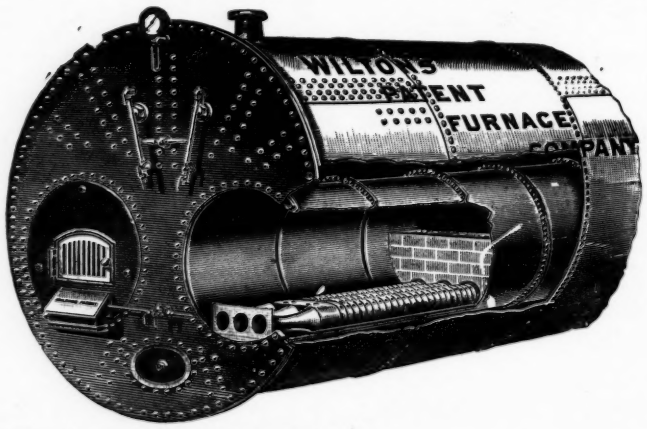

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EDITORIAL NOTES—GAS, &c.

Second Thoughts Concerning the Departmental Committee's Report.

A WEEK'S acquaintance with the report and recommendations of the Departmental Committee of the Board of Trade on the Testing of London Gas has not elevated the net results of the Committee's labours in the esteem of competent judges. On the contrary, the disappointment which was expressed with the findings of the Committee on the first sound of the nature of the official report is echoed from all sides; and the regret felt at the amazing failure of so eminent a body of men to understand the elements of the photometry of gas deepens with reflection. Really, it is the Committee who have been put upon trial, and found lacking in scientific acumen. The Board of Trade are to be commiserated with upon the failure of their well-meant endeavour to reduce to order and system, by the aid of Science, the highly technical questions, both of principle and detail, which have occupied the attention of Parliamentary Committees, and given rise to no small confusion in the gas legislation of the last four sessions. But the Department must already perceive that the effort to place all these things upon a sound, logical basis, such as would command the assent of all experts in this line of technic, and cou'd be used without further argument as a standard of future requirement, has miscarried. Of course, as we have already admitted, and have further discussed elsewhere, the Committee have done something to discredit the factiousness of the London County Council's attitude towards the London Gas Companies. But no great degree of eminence in science was necessary to brush aside the whole body of afflictive measures that the Council have been ill-advised enough to take against every Gas Company they have had parliamentary dealings with during the past four years.

The chief benefit which the Committee were disposed to extend to the Gas Companies—the abolition of lime purification for sulphur compounds—avowedly commended itself to their judgment for the same general reasons that weighed with Sir John Brunner and his Committee on last year's Crystal Palace District Gas Company's Bill. The conviction of the uselessness and noxiousness of this superstition was therefore not the discovery of this Committee, who are content, on the contrary, to say "Ditto" to Sir John Brunner. The report does not contain one word respecting the special evidence on this head brought before the Committee, which we venture to think will arrest the attention of the whole gas engineering profession when it is published. As to the minor, but yet important, checks proposed to be applied to the County Council's fancy for worrying the Gas Companies in every conceivable point of administrative detail, they are doubtless valuable so far as they go; but here again the victory is one of common sense and fair play over officialism and petty spitefulness, not of Science. They would not be necessary if the County Council were inspired with some of the good sense of the Corporation of the City of London, and ceased to regard every gas director and chief officer as a cheat and a liar. Here, again, there is no special call for Science to rule counsel.

It is just where Science, in the person of some of its best-regarded representatives, might well have been expected to impose a sovereign solution on a bundle of physical puzzles, that the Committee so lamentably break down. They do not seem to know the existing practice of the London Gas Referees, nor why it became so. It would have been more convincing if the report had referred to the result of the inquiry held by a previous Departmental Committee—that on Photometric Standards, in 1895. In this connection, readers should turn to the "JOURNAL" report of the proceedings of the Committee (Vol. LXVI., p. 189 *et seq.*), when deputations of gas engineers argued with the Committee the point of the proper use of the standard burner. The consequence of these representations was the adoption of a recommendation that, in ascertaining by the standard burner the number of candles representing the illuminating power of the gas, according to the meaning of the Acts, the gas should be burnt "at whatever rate is found requisite in "order that it may give a light equal to that of the prescribed "number of candles"—which, it must be remembered, was then 16 for all the Gas Companies concerned. This particular meaning of the recommendation was expounded by the Secretary of the Committee, Professor Vivian B. Lewes, in the conclusion of his communication on "The Work of "the Photometric Standard Committee," to the meeting of the Incorporated Institution of Gas Engineers, the same year. The Transactions of the Institution contain highly important statements on the point by Sir George Livesey, Mr. Hunt, Mr. Trewby, and others. The course recommended was subsequently taken by the Gas Referees; and their table photometer is based upon it.

The whole philosophy of the matter lies in the truth, which nobody now questions, that the "London" argand burner No. 1—the standard test-burner—is essentially a 16-candle-flame burner, for coal gas. It is not the best at that; and as 16-candle gas is now made for the London market, it could be used to greater advantage with the flame turned up as high as it will burn properly. The Gas Companies, however, were and are willing, for the sake of uniformity, to abide by the standard burner, used in the proper manner, as furnishing the datum for the computations of the statutory illuminating power of their gas. The result is merely a figure, which has no real significance for the consumer. The report calls it a matter of "nomenclature." So be it; but then, surely, one name is quite as good as another, where all are meaningless. Why suggest the abandonment of a means of arriving at a definition which is at least defensible on grounds of truth, and is intelligible—namely, that the test-burner is a burner for a 16-candle flame—and choose another which involves a demonstrable misuse of the test-burner? There is nothing gained for anybody by such a proceeding, which is, moreover, slanderous upon the gas, is contradictory of numerous Acts of Parliament, and, in a word, is simply reactionary. The worst of it is, as we remarked last week, that if every step away from the arbitrary rating of gas as of 16-candle power is to be measured by a gauge which is so notoriously misleading that it has been abandoned even for the limited use in which its errors are insignificant, and is known to get more unjust the farther it is produced, the prospect of any advance of the industry may as well be blotted out at once. And they call this Science!

The Proceedings of the Société Technique.

IT is a gratifying pleasure again this week to record the success of the annual meeting of another gas society—namely, that of our French colleagues of the Société Technique de l'Industrie du Gaz. From the full report to be found in the present issue of their sayings and doings—and both are equally interesting—at their yearly meeting, which extended over four days of last week, it will easily be understood that the very long programme of the Paris Congress contained matter and variety enough for all. Though some of the thirty-two papers contributed may be of small importance, yet the quantity of the many and the quality of the few are ample evidence of the robust state of health and vitality of the Society representative of the gas industry in the friendly country across the Channel. That five papers should deal with the topical subject of mechanical stoking is significant of much; that M. De Brouwer should receive the honour of a gold medal for "having realized marked progress in

"apparatus for the manufacture of gas"—his charging machine—is perhaps significant of more. M. De Brouwer's name is now enrolled on the French Gas Society's awards along with those of M. André Coze, Dr. Auer von Welsbach, and others. We think the recognition of his work by the Société Technique highly creditable both to him and to them; and we heartily express here our own appreciation and congratulation.

We have also mentioned above the "doings" of this year's French Congress of Gas Managers—referring thereby particularly to their visits to the gas-works at La Villette and Nanterre; the former carbonizing coal in horizontal retorts with the aid of one of the latest forms of stoking machinery, and the latter effecting the same object in inclined retorts. The year that sees a special award made in France to an inventor of a charging machine, witnesses also, after twenty years' waiting, the first complete modern installation of inclined retorts in the country of M. André Coze. Such a juxtaposition suggests interesting possibilities. After the lapse of a further twenty years, who can tell upon what lines progress will have been made? This, however, we know, that by such organizations, by such meetings, and by such energy as we look for from the Société Technique de l'Industrie du Gaz en France, and from similar institutions in whatever country, the truly scientific spirit is fostered and developed, and the cause of real advance is furthered.

The Port of London Bill and Dues on Coal.

Among the Government Bills of the session which do not seem to have many friends must be numbered the Port of London Bill, which the Prime Minister piously hopes to pass some time between now and September. It is a measure which appears to stand in the same category as the Valuation Bill, inasmuch as its friends, if there are any, are silent; while its opponents are at least vocal, if not numerous. The Bill really is of very great importance, not the smallest of the interests affected by its proposals being the shippers of coal into the Thames. It was some time before the coal trade of London awoke to the fact that the Bill threatened to place the trade under new port charges of uncertain amount; but this seems to be the prospect. The measure comes down to Parliament as a remainder from last session, when it was dealt with by a Joint Committee. It now stands in the Orders as a Bill to establish a Commission for the Administration of the Port of London; transferring to the Commission certain dock undertakings, and also powers at present exercised by the Thames Conservancy and other bodies. It is not our business to go into the details of the Bill, other than the clause relating to the right of the Commission to levy dues on goods that come into the port, which certainly do not exclude coal. Clause 12 proposes that, as from such day as may be fixed by a Provisional Order made by the Board of Trade, "all goods "imported from parts beyond the seas or coastwise into the "Port of London or exported to parts beyond the seas or "coastwise from that port, shall, subject to any exemptions "or rebates which may be contained in any such Provisional "Order or allowed by the Commission, be liable to such "rates as the Commission may fix."

This is the provision feared by importers of coal, especially gas coal, into the London river, which has hitherto been free, unless actually landed at a wharf. It appears from a statement in the "Iron and Coal Trades Review," that the representatives of the seaborne coal trade of London have circularized members of Parliament against the Bill; but have fallen under the singular illusion that the preponderance of the Metropolitan trade proper is in railway-carried coal, which may create the impression that the shipping interest in the subject is not great. The fact of the matter is, of course, that it is house coal chiefly which is carried to the London market by railway. By far the greater bulk of gas coal, and coals of cheaper grades employed for factory purposes, water-works pumping, and so forth, comes into London by sea; and the comparative incidence of a due of 3d. per ton, or perhaps more, which is talked about in this connection, would be a heavy impost. Unfortunately, the prospect that the Commission would be empowered to tax gas coals would commend the Bill rather than the contrary in the eyes of the Metropolitan governing bodies, who have never ceased to regret the abolition of the old coal dues.

The position of the coal traders in regard to this question of dues or taxation of coal is intelligible and consistent. They object altogether to everything in the shape of a duty on coal, wherever levied, and for all purposes. They are in the painful predicament of custodians of a preserve which Governments and Local Authorities alike wish to enter, on revenue-raising expeditions which the keepers call poaching. For example, the trade is anything but reconciled to the coal export duty; and we have just received a broadsheet of protests against the view of the matter taken by the Chancellor of the Exchequer on the 12th of April, which purports to issue from the Coal Trade Offices, Newcastle-upon-Tyne, but bears neither signature nor imprint. This is scarcely the way to publish a statement dealing with such a subject. Unfortunately for the advocates of a return to the old free export system, public opinion is against them; and they are apparently unable to furnish a single argument of any strength to turn the current the other way. The document before us contains the general observation that "those interested in the trade point out the unfairness of "being called upon to pay, in addition to their ordinary "share of the general taxation, an exclusive tax to meet "expenditure incurred for the benefit of the nation as a "whole." The case is far from being singular, as there are very many trades in taxed commodities, in respect to every one of which the same plea for exemption is preferred. It is plain that revenue for public purposes must be raised; and very many people think that exports of British coal can easily contribute a fair share to the National Treasury.

The Private Sidings Bill Read a Third Time.

The fortunes of the Railways (Private Sidings) Bill have been sympathetically watched by owners of these reputed conveniences, which not infrequently prove disappointing in actual experience. The Bill was noticed in these columns when it went before the Standing Committee, and it seems to have fared pretty well before this inquisitorial body. It was the first order of the day on Friday; and three amendments appeared on the paper. Two of these were in similar terms, providing that before making an Order under the Act, the Railway and Canal Commissioners should satisfy themselves that adequate siding accommodation had been provided by the applicant for dealing with the traffic passing over the junction, so as to avoid causing any obstruction or delay on the railway. It was also proposed to throw on the trader the cost of signalling, and to make provision for the alteration of Orders. Since the matter has been in hand, a legal decision has been given to the effect that a private siding cannot be made unless the owner is prepared to run his trucks over the railway himself. This reading of the law was unexpected by the parties, and constituted a state of things which required remedying. This is what comes of perpetuating statutes passed at one era through all subsequent time, when the conditions are changed. At first, the railways were all of them mere toll-takers, like canal companies, and did not do all the work of their own lines, as they do now. Eventually, a compromise was arrived at, by simply making provision for varying an Order if the Railway Commissioners were satisfied that there was a *primâ facie* case for an alteration. Another proposed amendment was for applying the facilities provided by the Railways Clauses Consolidation Act, 1845, in respect of lands adjoining railways, to the case of the sidings. This was a question of giving rights to landowners to make connections with the sidings; but, after a good deal of talk had been expended in support of the proposal, it was discovered that the objects sought are already provided for in the Railways Clauses Consolidation Act itself. Consequently, the clause was withdrawn, and the Bill read a third time. It is so increasingly difficult nowadays to get any private members' business through Parliament, that the passage of even so unpretentious a measure as this savours of the exceptional. Owners of private sidings ought to find their interests materially served by the Act, which will at any rate strengthen their hands in dealing with the Railway Companies. It can be readily believed that the latter are quite willing to fall in with the requirements of their customers. But their ideas of what is convenient, and for the best, as regards the service of sidings are not always the same for both parties; and the Act will for the first time give owners power to make their views of what is reasonable respected. It is to be hoped that the possibility of calling in the Railway Commissioners will act as a preventive of the necessity, which must always be costly.

Helping the Juniors and the Question of Funds.

We are glad that two correspondents this week in the district covered by the Yorkshire Junior Gas Association—Mr. J. H. Brearley and Mr. H. Townsend—have given their benediction to the scheme, shadowed forth by Mr. W. Cranfield in his recent address, for assisting the junior gas engineers to a greater knowledge of the chemistry of gas manufacture. The address may have suffered a want of attention through its appearance during the week of the Institution meeting; and now that the meeting is over, we are glad the gentlemen named have given us an opportunity of again inviting discussion. Mr. Townsend supplements the remarks made in the "JOURNAL" a fortnight ago regarding the all-important question of funds. It is a regrettable thing to have to talk about difficulty in securing the necessary funds for schemes of advancement in such a prosperous industry. But it is a fact; and a change would be a very welcome indication of an awakening to the importance of these things. Mr. Townsend speaks of the "splendid response" made to Sir George Livesey's appeal for "the sinews of war" for the contest over the mantle question. If memory serves us rightly, the success of that appeal was not due so much to numbers as to the generous support of the comparatively few. When the great engineering conference was held in Glasgow, and money was required for making the fruits of that conference of lasting benefit, the Honorary Treasurer of the Gas Section did not suffer from being surfeited with contributions. For the carrying out of the naphthalene inquiry under the auspices of the Southern Association, a second appeal had to be made for funds at the last meeting. Now there are several schemes requiring funds. There is the exhibition and the other projects of the Institution, together with this one of Mr. Cranfield. The wheels of progress must be lubricated; and those who enjoy the rewards of that progress must find the necessary money. The prosperity of the gas industry to-day has produced contentment, but we trust not lethargy, among those who hold the purse-strings.

Parliament and the Electrolysis Question.

There is not the slightest doubt that the authorities of the House of Lords and the Board of Trade have for the present fully determined that under no circumstances shall protection and compensation in connection with electrolysis be given to gas and water suppliers; and it is a matter for consideration whether the wisest course to take now, and as early as possible, would not be by some united action. Agreement between parties has no effect whatever. Promoters of Bills and Orders can, under existing conditions, and with the greatest of freedom and confidence, settle opposition by agreeing to the insertion of an electrolysis clause, knowing full well that the authorities at Westminster will protect them against their own action by expunging the clause before the Bill becomes an Act or the Order is confirmed. Only recently in the "Gleanings from the Committee Rooms," an account was given of the success of the Stretford Gas Company and the North Cheshire Water Company in effecting an agreement by which an electrolysis clause was inserted in the Manchester Corporation Tramways Bill and the Stretford District Council Bill. The Companies thought themselves safe; and it was quite a rude blow for them when the Lord Chairman gave notice of his intention to strike out the clause. Why the Lord Chairman should interfere with private bargains between two competent bodies when the bargain does not transgress any law, is a question which is now exercising the Companies and their officials. But it is no good reasoning why; the best thing is to see whether there is not a way of making such bargains possible, effective, and permanent, and next to ascertain whether something cannot be done to compel Parliament to see the seriousness and righteousness of this matter especially in the case of gas supply. In the cases of both the Bills mentioned, after the agreement that the electrolysis clause should be inserted, opposition was withdrawn, and the measures passed the Lords Committee, and were reported for third reading. Then in stepped the Lord Chairman; and the clauses were ruthlessly struck out. The procedure in these matters is running past one's comprehension. The two Companies, supported by the Manchester Corporation, appeared before Lord Balfour of Burleigh, and argued the matter. But Lord Balfour was as immovable as the Pyramids of Egypt, and simply waved all argument aside by stating that, after the decision of the House on the Beckenham Bill in July last, he had no other course open. The only chance of having the clause reinstated now would be by raising a debate on the third reading of the two Bills, and succeeding in getting the decision reversed. But what a chance it is?

A Further Tussle before the Board of Trade.

The Stretford Gas Company have fought well over this electrolysis clause business. Under circumstances mentioned when last reference was made to the matter in the "Gleanings," they were before the Board of Trade last Wednesday in connection with the Stretford and the West Manchester Light Railway Orders. In relation to the former Order, the Gas Company and the Manchester Corporation Water Department held the promise of the Stretford Urban District Council to insert an electrolysis clause; but the West Manchester (Trafford Park) Company altogether declined to concede it. Both Orders were up for confirmation before Sir Herbert Jekyll on Wednesday last, when Counsel for the Stretford District Council announced that he confirmed the arrangement between the Gas Company and the Manchester Corporation and his clients, and proposed to insert the agreed clause. The Manchester Corporation and the Stretford Gas Company were represented by Mr. Lewis Coward, K.C., who cogently placed before the Commission the difficulties and injustice surrounding this matter. The position, too, was explained by plans by Mr. Holme Lewis, on behalf of the Manchester Corporation, and Mr. H. Kendrick on behalf of the Gas Company. Mr. Lewis also gave evidence of direct injury to water-pipes, and produced samples. One of the cases was within the district of Stretford, where the electric trams have only been working some fifteen months. The others were on the hydraulic supply pipes within a few hundred yards of the Dickinson Street Power Station of the Corporation of Manchester. In each instance, the damaged section of pipe was just beneath the tramrail, while the other portions of the pipe on either side were in a sound condition. The soil had been analyzed, and nothing found in it to cause corrosion. In both cases, the electric supply cable was either absent or was at a considerable distance. The Commissioner, however, raised objection to the evidence on the ground that it was "all supposition." He said he would report to the Board of Trade, but that the Corporation and Company need not expect to have even the agreed clause inserted. It was pointed out that the Board of Trade were not consistent, and that they actually confirmed in May this year the Tramways Order of the Altrincham Urban District Council, in which are included protective clauses for the North Cheshire Water Company and the Altrincham Gas Company. The protective clauses include an electrolysis subclause in the same form as section 89 of the Manchester (Southern) Tramways Act, 1903. The appeal, however, seemed to have no effect on the Commissioner. He must be getting hardened to such things now.

Wasted Time and Energy.

The Stretford Company have taken legal opinion, and have decided that, in face of the confirmed opposition of the Board of Trade officials, it is useless to try to get a vote in the House of Lords which would reverse the decision on the Beckenham Bill. The Company have therefore spent a great deal of money with little or no compensating return. Writing on this matter, Mr. Kendrick says: "The hard part of Lord Balfour's decision is that, in Sale, part of the tramways authorized by the Manchester (Southern) Tramway Act, 1903, in which there is an electrolysis clause, is to be abandoned, and other tramways substituted by the Manchester Bill. We therefore lose the protection in these lengths, and get none under the new Bill. In addition, we get another burden added to our difficulties. In the roads in Stretford, through which the Manchester (Southern) Tramways are to run, the Manchester Corporation are to lay feeder cables, to supply the energy to that portion of the Southern tramway system outside Stretford; while the Stretford Council will supply, under the 1903 Act, those in Stretford. We are, therefore, in this position that we may get compensation from Stretford for damage done, but not from Manchester, even though the damage occur in the same roads. Endless confusion, it is obvious, may therefore arise." In view of the position of affairs, and the evident intention of the

Lord Chairman and the Board of Trade to refuse to insert even agreed clauses, it may be necessary for gas and water authorities and companies to take joint action to get together all available evidence, and make a joint onslaught on the Board of Trade and the House of Lords. It is quite clear that no relief will be given, if it can be avoided, until the damage is widespread; and even then the official mind will probably seek to shelter itself behind the Board of Trade regulations. One is inclined to ask, What share has the British Electric Traction Company in these proceedings?

Another Nuisance Case.

The hearing was commenced last Thursday, in the Chancery Division of the Irish High Court, of a case in which a firm of linen manufacturers seek to obtain from the Belfast Corporation £1500 damages for injury caused to their property by the issue of smoke, soot, "and other noxious matters and vapours," from the gas-works in Ormeau Road; an injunction being also sought to restrain the defendants from continuing the nuisance. Pending the publication in our pages next week of a report of the proceedings, the chief points of the statement of claim and defence may be briefly indicated. The plaintiffs are owners of a factory in Havelock Street, near the gas-works, which they contend has been injured, rendered unwholesome, and greatly deteriorated in value by the nuisance of which they complain; while their goods, in passing through the laundry connected with the business, have also been damaged. They state that the trouble has been going on for some years, and that, though frequent complaint has been made, the defendants have not remedied the matter. The Corporation, on the other hand, deny that they have caused to issue from any portion of the gas-works offensive matters or vapours, or any quantity of smoke or soot that would be a nuisance to the plaintiffs. They point out that for forty years there has been no complaint as to the alleged nuisance; and that by a deed, which has since been accidentally lost or destroyed, the former owner of the land now belonging to the plaintiffs granted the defendants the right of causing smoke, soot, and vapours to pass over and into the land—the alleged grievances being uses by the defendants of this right. Under their Act of 1874, the Corporation are obliged to manufacture gas upon the property in Ormeau Road; and they state that this manufacture cannot be carried on in any different manner. Judging from reports of the proceedings so far to hand, the case is likely to be a hard-fought one. The whole of the first day was taken up by the opening speech of Mr. C. E. Matheson, K.C.; while Friday was devoted to the hearing of evidence called on behalf of the plaintiffs.

In Aid of the Rates.

The question of how far local authorities are justified in allocating profits made on their trading undertakings in aid of the general rates, is one that is always more or less under discussion—at all events, as regards that branch in which our readers are mainly interested. No doubt this is to an extent accounted for by the fact that profits are so easily realizable on the working of a gas undertaking; while with some other municipal businesses (which need not be named) they appear to be exceedingly difficult—and in very many cases quite impossible—to obtain. During the past week or two, there have been several interesting discussions of the character to which we refer; and it is gratifying to note that the opinion seems to be rapidly gaining ground that the consumer of gas is the person who is entitled to first consideration. It is difficult to see what hardship to anyone there can be in this view of the matter; for inasmuch as the consumers are called upon to purchase the gas-works, they can fairly claim that they are doing something for the good of their town without any call being made upon them for a direct levy in aid of the general rates. The Bury Corporation have a clause in their Act by which one-half of whatever profits are made is handed over in relief of the rates, while the other half is devoted to the consumers. This, at least, has the advantage of being definite; but it does not seem to give universal satisfaction, judging by remarks made in the Town Council, a report of which appeared in last week's "JOURNAL." Here one of the members remarked that on a previous occasion it had taken three or four years to come to what was believed to be an equitable decision on the matter—namely, that a profit on the manufacture of gas should not be the first consideration, but that the price should be fixed as low as practicable, as it was proved that it was impossible to make a large profit without inequitably affecting the ratepayers. Much the same point was raised recently at Burton, where one of the councillors contended that it was not fair for one portion of the community to be called upon year after year to contribute large sums towards the relief of the rates of the whole community. The soundness of these views is not to be denied; but having regard to the usefulness of gas profits in assisting local authorities to make the rates appear less than they really are, it is not to be expected that under existing conditions any general agreement in this sense will be arrived at for dealing with the question. It is, however, interesting to note in this connection that the "Municipal Journal" is offering prizes for essays on the best system of municipal audit; and one of the points suggested for competitors to deal with is the extent to which the rates should be aided by profits on trading concerns. When the winning essays in this competition are published some months hence, we may get an idea of what are the views of accountants on this much-debated subject.

A Step in the Right Direction at Edinburgh.

As the result of negotiations between Mr. W. R. Herring, on behalf of the Edinburgh and Leith Gas Commissioners, and Principal A. P. Laurie, of the Heriot-Watt College, an arrangement has been come to which must prove of inestimable value to the chemical students of the latter institution. At an interview between the two gentlemen named, the suggestion was put forward that the Commissioners might afford practical training at the Granton Gas-Works to advanced students in chemistry at the College—more particularly with regard to fuel and fuel values, furnace and other gases, combustion, and similar investigations. The Commissioners, realizing the value of the facilities that they could offer in these respects, expressed their readiness to enter into any reasonable scheme which the Governors of the Heriot Trust might determine to adopt; and accordingly an arrangement has been come to whereby students who have been for two winter sessions in the chemical department of the College shall be permitted to attend at the gas-works for four months during the following summer, and those who have been in the department for three winter sessions shall attend at the works for a period of twelve months. The College authorities, of course, have no power to compel students to take one or both of these courses; but it has been decided that they shall not be considered eligible for the diploma in technical chemistry unless they have specialized in a particular branch of study, or have taken advantage of both the courses offered by the Gas Commissioners. Though, however, the whole scheme must be regarded as at the option of the student, the Commissioners very naturally stipulate that, should they commence to serve either one or both of the periods at the works, they will be expected to continue, unless a special arrangement is come to.

What It Means.

In a letter to the "Scotsman," Principal Laurie points out the importance of the agreement now arrived at with the Gas Commissioners, which he correctly describes as being entirely on the right lines for the training of the technical expert, and therefore well worthy of being brought into prominence. The object which the Governors of the College have at heart is the development of the training of the technical expert of the future; and, as Principal Laurie remarks, a modern gas-works, equipped with all the latest scientific appliances (like those recently erected at Granton), is capable of giving the broadest general training to the technical chemist. In such a works, the student becomes familiar with all the problems which lie at the foundation of every modern chemical industry and of all metallurgical operations—namely, those connected with the combustion of fuel and the analysis of fuels and of the products of combustion—as well as with the residuals produced in the manufacture of gas, which enter into so many chemical industries. Furthermore, he says, the student becomes acquainted with the carrying on of various chemical operations on a large scale, and learns how to deal with such problems when they may arise in the future. Thus no better all-round training could be devised

for the technical chemist than to spend a certain amount of time in the laboratories of a large modern gas-works. Under these circumstances, the arrangement which has been made between the Gas Commissioners and the Governors of the College is, Principal Laurie points out, one that will benefit everybody. The College will be able to offer to its chemistry students a course of training which will be thoroughly practical as well as theoretical, in character; the students will be turned out, not only theoretical chemists, but men to be trusted in dealing with chemical manufacture on a large scale; while the Commissioners will obtain a considerable addition to their staff of skilled assistants, who will work under the chemists already engaged by them without involving any further cost to the undertaking. The College authorities are to be congratulated on having secured for their students such unique facilities for the acquiring of knowledge, and the Gas Commissioners upon the broad view of the matter that they have taken. The departure is one that will be watched with considerable interest—more especially in view of the attention that is just now being paid to this question on behalf of the juniors of the gas industry.

Gas v. Electricity for Public Lighting at Canterbury.

In our "Electric Lighting Memoranda" to-day, reference is made to the recent opening of the gas-power station in connection with the installation of electric lighting at Faversham. Of course, there was the usual oratory suitable to the occasion, and one of the speakers was Alderman Mason, the Chairman of the Lighting Committee of the Canterbury Corporation. In support of the "forward" policy of Faversham, he cited the excellent results obtained in the cathedral city, where, he is reported to have said, the electric light has never cost the ratepayers a penny. The statement appeared to cause some little astonishment; and it was thought by many that some mistake had been made. As a result of inquiries, our contemporary the "Kentish Observer" was induced to look into the matter; and, at first sight, the statement of Alderman Mason seemed true on the face of the accounts. When they came to be examined, however, it was discovered that the electric light undertaking was made to appear profitable by the simple process of charging a large sum for the public lighting—a very convenient arrangement. For example, in the last year in which gas only was used (1898), the public lighting bill for 444 lamps came to £1584. For the twelve months ending Lady Day last, the amount was £2588; the rates being charged with £730 for gas and £1858 for electric lamps. The total is an increase of £1003 on the amount paid for the 444 gas-lamps in 1898. This would be endurable if there were a manifest improvement in the light. But this does not appear to be the case. Our contemporary says the inhabitants are paying this additional large sum for the public lighting of the streets, and are really getting nothing extra for it; "the illumination provided by the electric lamps being most inadequate." Another point brought out in connection with this matter bears upon the rating. The Gas Company pay on their £71,026 of capital £698 for their gas undertaking only; while the Electricity Department of the Corporation pay £237 on £54,028. If the two undertakings were rated on the same footing, the department would have to pay £50 more in rates and taxes. It is not a large amount, it is true; but there does not seem to be any special reason why it should not be charged.

WATER AFFAIRS.

Papers at the Conference of Water Engineers.

THE time at the disposal of the members of the British Association of Water-Works Engineers, on the occasion of their recent annual meeting at Hull, was inadequate for the reading and discussion of all the papers of which the titles appeared in the programme. Consequently, the one by Mr. G. Mitchell, describing the Appleton extensions of the Warrington Corporation Water-Works, had to be passed over, and two others summarized by their authors. They will probably, however, be considered at the winter meeting; in any event, they will be valuable additions to the proceedings. Of the five papers read, that which was the combined production of Messrs. Meysey-Thompson and Hugh Lupton, the principal portions of which will be found, with some notes of the discussion thereon, in another part of the "JOURNAL," was the one that touched most closely the every-day work of the water engineer; for though he may be occasionally exercised on the subject of the best material to be used for the construction of reservoir embankments, pumping is always with him. The cost of performing this operation is therefore a matter which calls for his most serious attention. First of all, there is the capital outlay for the plant; and then there is the expense of working it. While candidly acknowledging that the number of different types of engine now in use is bewildering, the authors endeavoured to offer to the members some instructive remarks upon each, and of their working costs; and they gave a useful table containing figures showing the actual cost of pumping for a complete year in various towns. Interesting as the paper was, we must confess to sharing the regret expressed by Mr. Crowther, of Wallesey, that it was simply a record of facts, and that its authors had not done full justice to gas as a motive power for pumping. The point was taken up by Mr. C. E. Jones, who opportunely called attention to the supersession of solid by gaseous fuel which is now going on. The utility of gas-engines for driving pumping plant does not require emphasizing here, in view of what has only lately appeared in our columns. The question is, are they more economical than steam-engines? Mr. Meysey-Thompson says they are not. But before accepting this dictum, it would be advisable to have additional data. We therefore cordially support the suggestion made by Mr. Dewhurst that the members of the Association should furnish, for tabulation, information in respect of their particular plants; and if in these statistics the cost of gas, oil, and electricity, in comparison with steam, could be embodied, their value would be enhanced. The suggestion should not be lost sight of.

Reference to statistics leads naturally to the consideration of a point made by Mr. R. E. Middleton, in his paper on "The Administration and Control of the Nation's Water Supply" (unavoidably held over), bearing out the suggestion offered at the close of the President's address. There appears to be a very real demand, in connection with water supply, for annual returns on the lines of those which have for some years been presented to Parliament in regard to the authorized gas undertakings of the United Kingdom. The key-note of the paper was the advocacy of the constitution of a new set of authorities who should have jurisdiction, for purposes of water supply, over each of the great drainage areas into which the country is naturally divided, and be responsible to a central Government Department, specially created for the purpose, by whom they would be required to put in force the existing laws for the prevention of pollution, and make suggestions for their amendment. Upon these new bodies Mr. Middleton would put the duty of preparing the returns above alluded to, which it is suggested should comprise rainfall and meteorological statistics, particulars as to the gauging of rivers and streams, the quantity of water supplied, the capacity of storage reservoirs, and other data bearing upon questions of public health. At present there are in existence a number of small bodies possessed of indefinite powers; and a desire has been pretty generally expressed that they should be superseded by others endowed with distinct authority and limitations. The outcome of the paper and of the remarks to which it gave rise was the passing of a resolution instructing the Council of the Association to consider the questions raised by Mr. Middleton, who has been persistent in advocating the change proposed, with the object of bringing the views of the Association to the knowledge of the President of the Local Government Board. Though Mr. Long must be well aware of what these views are, seeing that he has had them laid before him from time to time, no harm will be done by keeping the subject well to the front. We do not know—and, judging by an answer he gave to a question last week, we are not likely to know just yet—what will be the scope of his Public Health Bill; but assuming it does not propose reforms in the direction indicated by Mr. Middleton, there will be no reason why an attempt should not be made to have them effected by amendments. If it should be unsuccessful, the proposed returns, which would be really useful papers, could be moved for independently, and their preparation imposed upon the existing authorities. The control and administration of the nation's water supply is a large subject, but not too large for the Association to take up.

THE DEPARTMENTAL COMMITTEE, THE GAS COMPANIES, AND THE REFEREES.

Last week, in discussing the report and recommendations of the Board of Trade Committee on Gas Testing in the Metropolis, we gave attention first and foremost, as in duty bound, to the Gas Companies' interest in the matter. We showed that the labours of the Committee do not, generally speaking, concern any other than the three London Gas Companies, with the exception that the best fruit of the inquiry—the condemnation of lime purification for reducing the sulphur compounds—was the outcome of the proof supplied that this requirement is only imposed on a very small percentage of the gas undertakings in the United Kingdom. It is impossible, therefore, that the condemnation of lime purification for sulphur compounds should not henceforward become operative everywhere. With the discontinuance of this practice, there will be closed a chapter of technical history which illustrates very pointedly the influence of Mandarinism on the gas industry of this country; and the end of the episode will not be marked by a single regret. True, some time must elapse before the last bisulphide box is thrown out of action; but that is a trifle. The practice, convicted of inutility and noxiousness, can only linger on until the opportunity comes for administering its *quietus*; and when this is well and truly done, everybody concerned will marvel at the long endurance of a mischievous and tiresome superstition.

It is only right, moreover, to make due acknowledgment of the other benefits and relieving measures which the Committee have granted to the London Gas Companies. These were referred to, in passing, last week; but their importance, great as it is, was overshadowed by the larger questions arising out of the recommendations. Let us therefore enumerate them now. They cover the test for sulphuretted hydrogen; the discountenancing of the proposed use of the portable photometer for penalty testing; Sunday testing; the reference of disputes to the Chief Gas Examiner, and the consequent removal of technical forfeiture cases from the Police Courts. This is a substantial list of grievances redressed, for which the Gas Companies, and in particular their responsible officers, have much reason to thank the Committee. It is recommended that the prolonged Referees' test for sulphuretted hydrogen should be replaced by the test for this impurity prescribed by the Gas-Works Clauses Act, 1871, or, at any rate, something not more severe, to be prescribed by the Referees. The existing statutory provision, which requires the gas to be wholly free from sulphuretted hydrogen, has been interpreted in the spirit in which Portia regarded Shylock's bond; and this has been recognized after more than thirty years as impracticable. The fad of the London County Council for the portable photometer has been a vexatious innovation on the practice of testing for illuminating power; and it is satisfactory to note that, in referring to this matter, the Committee explicitly pronounce in favour of the Companies' view that the object of penalty testing is to examine "the bulk of the gas supplied," not to hunt out every hole and corner where gas, as it eventually reaches the consumers' houses, may have suffered detriment on its winding way. The still newer passion of the London County Council for Sunday testing is frowned upon; the Committee declaring that they can see no advantage in it.

A notable amelioration in the method of working the Metropolitan gas-testing arrangements is proposed under one of the recommendations (*h*): "That differences between the Gas Companies and the Referees as to the reasonableness of any requirements of the Referees should be referred to the Chief Gas Examiner, whose decision should be conclusive and binding on both parties." Hitherto there has been no speedy and easy remedy for deadlocks between the parties, which in point of fact have been rather frequent, especially of late years. There can be no sound objection to making the Chief Gas Examiner the arbiter of reasonableness. Furthermore, if there is to be such an officer, charged with the duty of "seeing fair" between all the parties concerned in respect to the highly technical requirements of the law of gas testing, it is desirable to make full use of him. During the past thirty-five years, certain considerations of this order have emerged from the record of the execution of the statutes; and among other things, there has arisen a strong demand, on the part of the Gas Companies, that they, by their officers, should not be placed in the position of malefactors, or misdemeanants, in being haled before a Police Magistrate for technical breaches. It has naturally resulted from this antiquated arrangement, that the Companies are pilloried extra-judicially in the newspapers for supplying "bad gas;" and the effect has been to create and foster a prejudice against them from which they have suffered in many ways. The London County Council, for example, think they are doing the community good service by thwarting and hampering in every possible way the Companies who supply the gas which every cheap newspaper in London reviles on the strength of these Police Court proceedings. This misunderstanding alone costs the London public tens of thousands of pounds annually, without anybody being one whit the better or wiser for the money spent. The Committee propose a reform which will go a long way to remove this scandal, by recommending that all proceedings for the recovery of forfeitures, and the assessment of their amount, in respect of shortcomings in illuminating power, purity, or pressure, should originate before the Chief Gas Examiner. The public would be adequately protected by allowing grave cases (if ever they arise) to go before the Magistrates as at present.

Well, now, having done so much justice to the best portions of the report and recommendations, which are precisely those that show how far the Committee were swayed by common-sense considerations, what is to be said of the remarkable and singular lapse from this state of grace betrayed in the findings of the Committee relating to the photometrical question, which is also the financial issue? Here is where the Committee, who throughout their observations and recommendations breathe the highest respect for the Referees—who, indeed, propose to continue in this body of experts the responsibility for prescribing new and additional tests for the gas—fly in their face, by absolutely stating their preference for a method of using the standard test-burner which has long been abandoned by the Referees, in the exercise of their discretion. Where is the sense of referring anything to the Referees, if at the same time their existing practice in photometry is condemned? What ought the Referees to do in the circumstances thus created? Their own table photometer, which every user of such instruments speaks well of, is by implication relegated to the scrap heap; and the Referees are, in so many words, told to begin their work again without it, on a system which they have discarded. Of course, if the proposed alteration of the use of the standard burner were defensible as an improvement, it would only be necessary to agree that the Committee have taught the Referees their business, and proceed to correct one's ideas accordingly. But the truth is demonstrably otherwise. The Referees well knew what they were doing when they changed their system of testing gas, preferring to work with the 16-candle flame rather than with a gas consumption at the rate of 5 cubic feet per hour. To say they were wrong, as the Committee have done, is a judgment the consensus of competent opinion will not respect. The Referees do not in the remotest degree deserve such a reflection upon them, nor are the Committee warranted in passing it.

The dictum as to the way in which the Committee think the standard burner should be employed becomes almost ludicrous when one proceeds to inquire into the reasons offered in excuse for it. They make no attempt to show that the burner can be properly used indifferently, as they recommend, or as it is prescribed to be used by the statutes relating to the testing of London gas, and interpreted by the Referees. On the contrary, they admit that what they recommend depreciates the nominal quality of such gas as is of less illuminating power than 16 candles for 5 cubic feet. The use of the burner is only indifferent in the case of what is recognized as 16-candle gas. Yet, as they say, merely for the sake of defining the quality of the gas without ambiguity, it is preferable to go back upon the counsels of the Referees, and restore their discredited method! The irony of the situation is, that equal exactitude of definition is obtainable by the existing method. The whole thing is conditional. The illuminating power of gas is an inferential classification, not a positive physical character. It is more akin to the flash-point of petroleum than to the specific gravity of a substance. One can therefore define it in any terms one pleases, provided that they relate to standard conditions, verifiable and reproducible at will. The condition with which one must start is the standard burner, which is prescribed by law. The method of using this burner is likewise prescribed by Act of Parliament—that it shall be to the best advantage of the gas. When the Act was passed in 1868, and for long afterwards, 16-candle gas was made only from coal, enriched by cannel; and this was the gas for burning which at the rate of 5 cubic feet per hour the standard burner was made, and the larger chimney prescribed. Such gas has long disappeared from the London market. Still, not to make too long a story of it, the Gas Companies were willing to keep the standard burner, provided it was used at the 16 candle flame rate for which it was made. It was this light-effect which determined the *régime* of the burner, as the Referees recognized—not the rate of consumption of the gas. On this basis, 16-candle gas is definable as the gas which yields the light of 16 candles in the standard burner, with a gas consumption at the rate of 5 cubic feet per hour; 14-candle gas is that which requires the burning of a proportionately larger quantity—to wit, 5·71 cubic feet per hour—to yield the same amount of light. By the same reasoning, 18-candle gas would be burnt at the rate of 4·44 cubic feet per hour to yield the light of 16 candles in the standard burner. The method to be followed is not indifferent, inasmuch as the standard burner will not burn 18-candle coal gas at the rate of 5 cubic feet per hour. Neither should it be forced to burn gas of a lower quality than 16 candles at the hard-and-fast rate just named. What happens to 14-candle gas by the above measurement, is admitted by the Committee. They call it 13-candle gas; and they ask what difference can be made to the Companies who manufacture it by a mere alteration of nomenclature. Is not the description true? Certainly it is; and in this connection "the greater the truth, the greater the libel." The recommendation is, in short, as unacceptable to the parties most concerned—the Gas Companies and the Referees—as it is to be deplored on every ground of equity and common sense. It begs the question which the Committee were directed to answer, and goes far to neutralize every other good effect of the investigation.

THE REPORT OF THE BOARD OF TRADE COMMITTEE.

By HAROLD G. COLMAN, Ph.D., M.Sc.

The report of the Committee appointed by the Board of Trade to consider various questions relating to the statutory requirements as to the illuminating power and purity of the gas supplied by the Metropolitan Gas Companies has now been published; and their recommendations must receive the consideration not only of the suppliers and consumers of gas in the Metropolitan area, but also of all who are in any way concerned with the gas industry throughout the country.

The three most important points of the inquiry were as follows: (1) Whether the statutory compulsion to reduce the sulphur compounds other than sulphuretted hydrogen should be continued, and whether the severity of the test for sulphuretted hydrogen should be diminished. (2) Whether any alteration should be made in the requirements as to the illuminating power to be supplied. (3) In what manner the illuminating power of the gas should be ascertained.

With regard to (1) very little need be said, as the recommendations of the Committee practically agree with the views put forward by the Gas Companies—namely, that the only sulphur compound which should be compulsorily removed is the sulphuretted hydrogen, and that the test for the latter should be the less severe one prescribed by the Gas-Works Clauses Act of 1871; no alteration being made in the sliding-scale on account of these relaxations.

So far as (2) is concerned, the Committee record their opinion, based on the evidence they heard, that the lowering of the illuminating power is to the disadvantage both of supplier and consumer; and seeing that the Gas Companies were not in agreement among themselves on the point, this result is hardly surprising. The wording of the report seems, however, to indicate that while they think, on the whole, the balance of evidence is against such a reduction, they do not regard the disadvantage as of sufficient importance to recommend that the South Metropolitan and Commercial Gas Companies should be compelled to revert to the supply of 16-candle gas. At the same time, so long as such divided opinions are held on the subject, they are "clearly" of opinion that no compulsory reduction of quality should be made in the case of the Gaslight and Coke Company.

The pronouncement of the Committee in this matter cannot therefore be regarded as in any way definitely settling this important question. The point at issue is a very complex one, and involves, among other things, somewhat intricate commercial considerations; so that any Committee appointed to consider this matter should include not only representatives of pure science and the gas industry, but also some who are connected with large commercial undertakings other than gas manufacture.

The recommendatians of the Committee on the third point—namely, the method to be employed in determining the statutory illuminating power—are, however, the ones which require the immediate attention of the whole gas industry; for although the recommendations refer to the Metropolitan area only, the final decision in this respect will doubtless, later on, be made applicable to the country as a whole.

The matter in dispute between the South Metropolitan and Commercial Companies on the one hand and the London County Council on the other, referred to the Committee, related in particular to the method which should be adopted in determining the illuminating power of the 14-candle gas supplied by these two Companies. The latter maintained that when testing the gas, it should be burned in the "London" argand burner at such a rate as to give a light of 16 candles; the illuminating power for 5 cubic feet being then obtained by calculation from the volume of gas actually passed. The County Council, on the other hand, held that the gas should be burned at the rate of 5 cubic feet per hour in the same burner. It was admitted on both sides that a gas which gave 14 candles by the latter method would give something like 15 candles by the Gas Companies' method. The net result of a decision in favour of the County Council's method would be that the Companies would have to supply a gas of about 1-candle power higher than is at present the case.

So far as this matter is concerned, the decision of the Committee substantially confirms the position of the Gas Companies, as they state that they do not propose any alteration of the actual quality of the gas made by the two Companies supplying 14-candle gas—*i.e.*, that the actual quality supplied shall continue to be such as would give a light of 14 candles when tested in the No. 1 "London" argand so as to give a light of 16 candles. So far, therefore, the result is satisfactory; but additional recommendations follow which open up a question entirely distinct from that raised by the London County Council.

In these, the Committee propose that, in making the tests for illuminating power, the gas shall always be burnt at the constant rate of 5 cubic feet per hour; and in order that this may be done without causing any alteration in the actual quality supplied, they suggest that the nominal illuminating power of the gas furnished by the South Metropolitan and Commercial Companies shall be altered from 14 candles to the figure which the same gas would give when tested at the 5 cubic feet rate. From paragraph (6) of the report (*ante*, p. 728), it appears that the Committee believe that the 14-candle gas now supplied would give a value of 13 candles when tested at the above rate.

The Committee state that they have been led to select this method because it is desirable that the conditions under which the gas is burnt during the test should be the same for all qualities. With this object, all connected with the gas industry have the fullest sympathy; but it is safe to say that the great majority are very strongly of opinion that the method recommended will be very far from achieving the desired end.

The recommendations assume, in the first place, that gas giving a value of 14 candles, when tested so as to give a light of 16 candles, will give on the average 13 candles at the 5 cubic feet rate. It does not appear from the report whether this result has been experimentally obtained, or whether it is only an estimate based on the assumption that because 15-candle gas under the first-named conditions becomes 14 candles under the latter, therefore 14-candle gas will give a value of 13 candles under similar circumstances. Such a conclusion would not be justifiable; for the difference between the values obtained by the two methods increases very rapidly as the quality becomes lower. This is well shown by the figures recently given by Mr. Abady in his lecture on "Photometry" before the North of England Association (*ante*, p. 304). From the table there published, it will be seen that three samples of gas supplied by different companies which gave approximately 14 candles (actually 13·73, 13·65, and 13·60) when tested in a "London" argand with a 6-inch by 1¾-inch chimney so as to give a light of 16 candles, only gave 11·1, 10·7, and 9·45 candles at the 5 cubic feet rate; and the experience of the writer agrees generally with these figures. Unless, therefore, these results are proved to be incorrect, the imposition of a 13-candle standard at the 5 cubic feet rate would mean that the Gas Companies concerned would have to supply a higher quality than at present—a state of things which the Committee specifically declare that they do not recommend.

Further, while the Committee fully recognize that the nominal value attributed to the gas by the specified method does not give a true representation of its comparative value to consumers, they do not regard this as a matter of any importance, as the object which they have in view is solely to define the quality of the gas, and to see that what the Companies supply fulfils this definition. But although this value may only be *intended* to be taken as a nominal value for identification purposes, it will appear in all returns as the statutory quality of the gas, and will then inevitably be taken by those having no technical acquaintance with the subject (which class will include the great majority of gas consumers, actual or prospective) to represent the comparative value of the gas for all purposes; and the result will be that gas undertakings will be seriously hampered in their competition with the rival forms of lighting, heating, and power production, and many cases will occur in which gas will lose in the competition, not on its merits, but simply because of the incorrect nominal quality attributed to it. While it will be generally admitted that competition has been on the whole of the greatest benefit not only to gas consumers, but also to producers, it is at the same time essential that the competition should be fair, and that none of the rivals should be hindered by an artificial circumstance such as the one now under consideration.

One or two examples of what will happen may be given; and in these it will be assumed that the nominal value of 13 is what the present 14-candle gas will give at the 5 cubic feet rate, and if the actual value is lower, the arguments will hold the more strongly. The average consumer will believe that the comparative value of the gas supplied by the Gaslight and Coke Company on the one hand, and the remaining Companies on the other, is as 16 : 13, or that the latter has 81 per cent. of the value of the former. A very large and constantly increasing proportion of the gas is, as the Committee recognize, now employed for the purposes of incandescent lighting, heating, cooking, and power; and in all these cases the most important factor is the calorific power, which really represents the total potential energy of the gas expressed in heat units. Now, taking Mr. Abady's table already referred to, it will be seen that the 16-candle gas had a calorific power of 608 B.T.U., while the average calorific power of the 14-candle gases (which will have, at the proposed 5 cubic feet rate, a nominal value of at most 13) is 583 B.T.U., and the actual comparative value of the lower quality gas in this respect is therefore 96 per cent., instead of 81 per cent., as will be mostly assumed.

Again, while it is true that the authorities who carry out the testing of the gas against the Gas Companies are only concerned in seeing that the gas is of the quality defined by Act of Parliament, the gas undertakings themselves, in the carrying on of their business, must necessarily make tests which give as nearly as possible the comparative value of different gases. Thus, in valuing the coals previous to purchase, the most important factors are the volume of gas produced and its true quality; and if the illuminating power were determined at the 5 cubic feet rate, the results—especially in the case of the coals producing a low-quality gas—would be utterly unreliable. Thus a coal giving a gas of about 16 candles would be correctly valued; but one which gave a poorer quality would be greatly undervalued. The result would, therefore, be that the tests for these purposes would have to be made by a different system to that used in identifying the gas

sent out from the works; and it would then be still more difficult than at present to judge with any approach to accuracy the quality of the mixed gas which would result from the carbonization of different mixtures of coals. In fact, the insistence on the 5 cubic feet rate would greatly increase the difficulties of the manufacturers in carrying out what is the real object of outside testing—namely, the production of a gas having a quality as uniform as is reasonably practicable, and not falling below a certain specified standard.

A further practical difficulty is found in the fact that, during the past few years, the whole of the photometers in the Metropolitan testing-stations have been replaced by table photometers in accordance with the instructions of the Gas Referees, following on the recommendation of the Board of Trade Committee of 1893 that the 5 cubic feet rate should be abolished. The essential principle of the table photometer is that the gas shall be tested at such a rate as to give a constant light in the burner, and cannot be used for making tests at the constant 5 cubic feet rate. Hence, if the recommendation of the Committee of 1904 is accepted, the whole of these photometers will have to be superseded, and their place again taken by bar photometers.

These examples could easily be multiplied, but sufficient has been said to show that the adoption of the 5 cubic feet rate for purposes of definition and identification would lead to very serious disadvantages, and against these the sole advantage gained is that *one* of the conditions of testing would be made constant. But this latter would not in reality render the conditions of testing uniform as a whole; for the result of fixing a constant rate for all qualities of gas is to make the condition under which the gas is consumed in the burner very far from uniform, inasmuch as the gas is then burnt in presence of an unsuitable quantity of air, unless it happens that the quality of the gas is 16 to 17 candles. There is, in fact, no means at present known by which uniformity can be obtained both as regards rate of consumption and conditions prevailing in the burner; and the question to be decided is which of these factors it is best to make uniform. In the method of testing now adopted for London gas, whether 16 or 14 candle, it is the burner conditions which are made approximately uniform by burning the gas so as to give a light of 16 candles; and this method has quite as good claims to uniformity of conditions as that recommended by the Committee. The method attributes to the gas a value which is at least as suitable for defining and identifying the gas as that obtained at the 5 cubic feet rate, while it is free from the disadvantages attending the latter procedure. The candle power thus recorded is not the highest which can be obtained from the gas in any burner, or at any rate of consumption—as may be seen by a further reference to Mr. Abady's table. But on the whole it fairly represents the comparative value of different gases to the consumer; for while it probably slightly exaggerates the relative quality of the lower grades for consumption in flat-flame burners, it distinctly minimizes the comparative value of these grades for purposes in which the calorific power is the main factor. Moreover, the same method can be adopted by the manufacturers in the tests which they have to make for their own purposes, and it can be used equally well with both the table and the bar photometer; whereas with the 5 cubic feet rate only the latter can be employed.

In considering this question of uniformity of conditions in photometry, another point must not be lost sight of—namely, that besides the conditions controllable by the operator, there are others considerably affecting the results, which are largely beyond his control—such as the height of the barometer, the temperature of the air, and the percentage of moisture and carbonic acid present. It is, therefore, of great importance that the controllable conditions should be so arranged that those which are uncontrollable should have the least possible influence, and thus reduce the unavoidable experimental error to the lowest limit. When varying grades of gas are tested at the 5 cubic feet rate, the proportion of air present in the burner to that required for the complete combustion of the gas increases, with lowering illuminating power, and thus augments the influence of the uncontrollable factors, moisture and carbonic acid, and consequently increases the experimental error; whereas when the gas is burnt so as to give a light of 16 candles, the above proportion is fairly constant for all qualities, rendering the experimental error also approximately the same in all cases.

It is, therefore, earnestly to be hoped that, in the interests of all concerned, the recommendations of the Committee, so far as they relate to the employment of a constant rate of 5 cubic feet per hour in the photometric valuation of all qualities of gas, will not be adopted.

"Field's Analysis" for 1903.—The well-known analysis of the accounts of the principal gas undertakings in England, Scotland, and Ireland, which bears the name of Field, has reached its 35th year of publication; but the latest issue, dealing with the accounts for the year 1903, differs from its predecessors in one significant particular—viz., that the title-name no longer appears upon the title-page as the compiler, but that of Mr. George Orford, the Assistant-Accountant of the Gaslight and Coke Company. In other respects there does not appear to be any change in the character of this very useful work. The statistics now presented furnish proof that the gas industry continues to flourish, notwithstanding the existence of competitive illuminants.

CONTRACTOR DESIGNED WORK: AUDI ALTERAM PARTEM.

[This article is composed of communications from a firm of contractors who have no wish to make this the means of advertising themselves, nor are they desirous that it should have any adverse influence on their business connection with gas engineers. The article must not be taken as of editorial origin; but, in the interests of free discussion, we have undertaken to present the protest and criticism in this form.]

THERE are always two sides to a question—sometimes more than two; and, in many cases, it would be a piece of arrogance on the part of anyone (with the reservation mentioned below) to assert positively that he is so infinitely wise and clear of vision that he can see and judge a question in all its bearings, and from the standpoints of men concerned in, but pursuing different walks in relation to, it. To do this, the primary qualification is needed that the man presuming to judge must have himself pursued all those walks—must be trained and experienced in them all, to make him competent to pronounce the complete and unimpeachable verdict. Otherwise, practical perhaps from one point of view, his views from the other sides will be nothing better than those of the mere idealist.

May not these observations be applied to the portion of the interesting address of the President of the Institution of Gas Engineers in which he treats of contractor designed work? This is one of those questions (of many sides) which few men are capable, from training and intimate experience, to fairly judge in all its different aspects. It is one which can be looked at from the standpoint of the consulting and trained engineer; from the standpoint of those gas managers whose attention has been diverted "partly and, in cases, almost exclusively, from the engineering and technical sides" of their work by the pressure of the duties of administration of the manufacturing and commercial branches of the gas business, or who have not had the opportunities of Mr. Jones and those in the rank immediately succeeding the one in which he so brilliantly shines; and, again, from the standpoint (if they may be allowed one) of the contractors. Can it be said that this particular question can be viewed with unprejudiced eye by Mr. Jones, trained in engineering work and now a consultant, through the glasses of those of his less fortunate brethren, and through those of the contractor whose life is spent, day by day, in designing, making, and perfecting plant for use here, there, and everywhere, and to an extent with which not even the practice of a gas consulting engineer at Westminster could hope to vie? With all deference to Mr. Jones, to his training, and to his experience as a gas-works administrator, and a designer in a more circumscribed field than those in which the chief gas-works contractors engage, the answer will not be universally in the affirmative. With what he says as to the training of the mechanical engineer being essential to all engineers, and not the least to the gas engineer, it is possible to fully agree; but he fails to show how, excepting in the case of the favoured few, that fundamental training is to be acquired. The gas-works of the country cannot give it to them; the shops of the contractors against whom the President so vehemently rails, are the only places where a complete, practical, specialized training can be obtained. But the shops of the contractors cannot serve as a nursery for all the gas-works in the kingdom, and for the contractors' own purposes as well. That is only one aspect of the matter. Another is that the gas-works of the country, or at all events a large proportion of them, do not, and cannot, pay a salary commensurate with the perfect engineering training that Mr. Jones prescribes. *Ergo*, how many men can devote hardly-earned money and years of their lives in attaining an engineering proficiency for which they can never hope to obtain an adequate reward. Those works in which extensions and renewals, through limited environment, are only necessary by the process of a slow accumulation of business perhaps once in four, five, or more years cannot possibly afford to have a trained engineer, manager, and a man of sound commercial ability rolled into one at the price which such training should be able to command. It is largely a question of supply and demand. If there was the demand for such men, then the supply would be only a matter of time. The contractor, with his wide experience and efficient and well-remunerated (because specially trained) staff, has filled the breach, or has met the requirement of the times, and in a manner that has given absolute satisfaction and a high efficiency, as gas-works all over the country bear striking witness, without designs from consulting engineers, who themselves, it may be observed, are not backward in taking counsel with the much traduced contractor. Speaking of consulting engineers, what have they done to raise the status of the gas manager? There is an abundance of talk; but where is the action? A hundred and more years have passed since gas lights were first seen in London. In 1904—whisper it not to other branches of the engineering profession in Westminster—the Council of the Institution of Gas Engineers are beginning to move; that is all. Before Mr. Jones throws his next stone, he should consider what the contractors have done in bringing about high engineering efficiency among their own people, and as far as possible in gas-works, and then ask himself what the "consulting" and "trained" gas engineers have done. People who live in glass houses should exercise considerable care

when they indulge in such a pastime as stone-throwing. It is dangerous.

But from the general to the particular; and here it must be said that the President is not especially careful to deal with his subject in the least offensive manner. He has treated it from the standpoint of the trained and consulting engineer; and it is well understood how much a man in his position (forgive the impertinence!) would regard the contractor in the light of a competitor. Here his remarks are to be criticized from the contractors' standpoint. Mr. Jones adopts as illustrations one or two examples of work that, it may be, are bad—perhaps through the fads or fancies of the trained engineer of the gas undertakings referred to, and not through any fault of the contractor. He says nothing of the brilliant and lasting work that has been designed and constructed by gas-works contractors, and which they have taken a pride in carrying out. If it was desired to be offensive there are some notable examples of expensive gas-works plant in existence to-day for the genesis of which it would not be necessary to seek farther than Westminster.

The President makes this suggestion, which looks rather curious when considered with the work of the past standing boldly around us: "One important aim is that we should keep the designing and specification of our work in our own hands, rather than rely upon the suggestions of those who, though practically skilled in the manufacture of plant, have not the essential knowledge and experience of the operation of our various processes, their variations and incidents, and who have no interest (once the plant is completed) for its successful, profitable action." This remarkable statement and assertion strike defiantly at the contractor; and the latter part is, in most cases, absolutely untrue. One would imagine that the contractors have no reputations; that out of their shops no good thing can come. Is it by good or bad work that the extensive engineering establishments which have had their part—and a no mean one either—in the building up of the gas industry have grown and flourished? Is it by a lack of interest or otherwise in the performances of their plant that the contractors have earned and retained the goodwill and the patronage of the gas industry? Let Mr. Jones answer these questions in the negative if he can. He advises the keeping of the designing and the specification of work in "our own hands." That is good so far as he goes. His address, however, declares, in no ambiguous language, that this is impossible. Read l is remarks under the heading of "Training;" and there will be found the answer. Perhaps at the present time there are not more than 5 per cent. of the gas managers who are trained engineers; and in numerous works it is not necessary that they should be, as most of their work is either chemical or commercial. Are all these to go to Westminster for aid? It may, without fear of contradiction, be asserted that, when Mr. Jones first put down carburetted water-gas plant on the works of the Commercial Gas Company, he—consulting and trained engineer that he is—could not have sat down and produced the plans on which the plant itself was constructed. Who, then, produced them? Is it not possible that they came out of the office of one of the reviled contractors? But it is also asserted that contractors "have not the essential knowledge and experience of the operation of our various processes." Indeed! In many of the works of contractors will be found men who have had practical experience on gas-works, and it has yet to be learnt that there is any secret about the manufacture of gas—that there is anything unknown to the leading contractors and their engineers. Mr. Jones will pardon the inquiry whether it is not a fact that contractors are so well informed that they are continually inventing new methods and improving the old? Look at the weekly "Register of Patents" in the "JOURNAL," and then judge; glance round any gas-works, and put the question again. A long list could be made of inventions placed on the market by contractors, the advantages of which have resulted in economy and improved efficiency in many a gas undertaking. Can gas engineers, who have never been concerned in the manufacture of plant as a business, show any equally lengthy list of economizing and efficiency-yielding plant? Anyone with considerable leisure should examine the records to see what the President of the Gas Institution has done in the way of invention.

Humour scintillates in every one of the opening lines of the next paragraph; and the President must surely have written them with "his tongue in his cheek." "If there be some" (he says) "unskilled with the drawing-pen and unpractised in specifying, who find themselves in need, they should be [note the "should be!"] sure to find friendly—nay cordial—counsel, reference, and aid, from their more experienced or advanced fellows of all ranks, and be put in touch with those who can serve their purpose, and work out the necessary details." Yes, there is no doubt the unskilled and unpractised ones may have this "cordial counsel, reference, and aid" for 10 per cent. on the sum of the contract, *plus* out-of-pocket expenses, *plus* 2½ per cent. for bills of quantities, and *plus* 1½ per cent. for the lithographers. Then, after the contract is finished, the "advanced fellow" may draw the attention of Directors or Committee to the "unskilled" and "unpractised" condition of their manager, and recommend a smart engineer from his own office, and thus in all probability "advance" another "fellow." One cannot help speaking a little bitterly from knowledge of what has been done. After all, is not much of the "cordial counsel" contractor-made and sold second-hand? "Far better this [friendly—nay cordial—counsel] than that they should fall back upon the contracting engineer. . . . One too often sees works showing so plainly signs of the hands of the contractor, and evidencing his profit rather than the skill and ability of the engineer." There is shocking narrowmindedness and restriction of survey revealed here. As to profits, most large contracting firms are limited liability companies, and their turnover and profits are published. The figures do not show any evidence of wholesale robbery. The President suggests that contractors do not take any pride in their work, and only think of the profits to be derived from it. If this be so, how is it that contractors have often held the confidence for 30, 40, and 50 years, and continue to do so, of gas undertakings, selling gas at low prices, and paying good dividends? The President falls into illustration—taking the worst extremes that have passed under his notice; and so working, from his *ex cathedrâ* position, a serious injustice upon probity. Surely retorts equipped so as to cost £300 against £50 cannot be taken as a comparison between similar systems. Let Mr. Jones be fair, and tell us whether these settings were contractor designed, whether they were constructed under the supervision of a "trained" gas engineer, and whether or not the results justify the outlay. If not, will he say that such settings are fairly typical of contractors' work. Of course, there are many settings which would be dear as a gift. Again, "when purifiers cost 50s. per square foot instead of 10s." The only purifiers known to those making this criticism of Mr. Jones's address which cost 50s. per square foot, were designed by a firm of consulting gas engineers; and no contractor with honest name and a reputation for good work would think of designing purifiers to cost anything like that price—anyway, they have never been met with in the course of a great many years' experience. A contractor does not design costly and unnecessary details, but he usually avoids the making of eyesores and sacrifices everything to utility, which is good engineership. Comparisons of certain plant designed by "gas engineers" with contractors' plant of a similar character might be regarded as odious.

The President's remarks in the same connection on capital also invite comment; but there must be a limit to the criticism. One or two words will suffice. He ignores the point that low capitalled undertakings sometimes attain suddenly to high capitals when transferred to local authorities by arbitration. Remember Chard and Nantwich! Nor does he take cognizance of the fact that frequently sudden increases of capital are due to prosperity demanding them, and that these increases earn their profitable return. Why all the increases of capital should be placed on the shoulders of contractors, is beyond an ordinary being's comprehension. So perhaps the President will gratify the ignorance of contractors on this point?

When Mr. Jones's dogmatic statements on the whole subject are looked at by the contractor through the curtain behind which the consulting and trained engineer places him (where they are glad enough to privately interview him at times), and knowing what the contractor does as to how much engineers of all grades are indebted to him and his staff, he feels tempted to treat this part of the President's address as nothing better than a piece of burlesque. If it were not for the grave injury that it may do (among directors and committees) to a class of men who little deserve such discourteous treatment, they would be disposed to ridicule, rather than deal seriously with, this ungenerous attack. The matter is not exhaustively criticized here. The material at command is voluminous.

Southern District Association of Gas Engineers and Managers.—By invitation of the Directors of the Reading Gas Company, the Southern District Association will hold their meeting in that town on Thursday of next week. The day's proceedings will include a visit to the gas-works, and a trip on the Thames, probably as far as Maidenhead or Taplow. There should be a large muster of members to take part in so enjoyable an outing as this promises to be. Great alterations have been made at the Reading Gas-Works since the Institution of Gas Engineers visited them in 1894.

Improved Batswing Burner for Works Purposes.—We have lately been shown a simple improvement in the batswing gas-burner used mainly for works and outside lighting, designed by Mr. R. H. Winder, of York Street, Manchester. The object is to regulate the consumption of gas, and provide a stable light under varying pressures. In the ordinary batswing burner, the flame is subject to considerable variation according to the pressure of the gas. It is consequently often wasteful in consumption, while in addition the flame is frequently very irregular and ragged. To remove these objections, Mr. Winder has designed a small brass nipple, which is inserted in the bottom of the burner. It is perforated on the sides—the number and size of the holes being determined according to the special conditions required; so that these burners can not only be adjusted to regulate the consumption of the gas, but a more luminous flame is obtained, and the nipple places a very effective check upon any variations in the pressure. This improvement applies specially to the iron or all-brass flat-flame burners, and is mainly intended to provide a more reliable flame for outdoor lighting or for workshops and factories where burners are subject to rough usage. It has not been put upon the market as a burner to be employed for ordinary domestic purposes.

SOCIÉTÉ TECHNIQUE DE L'INDUSTRIE DU GAZ EN FRANCE.

THE THIRTY-FIRST ANNUAL CONGRESS—PARIS, JUNE 14 to 17.

REVIEW OF THE PROCEEDINGS.

[From Our Own Correspondent.]

No one can say that the members of the Société Technique du Gaz en France do not work hard at their annual meetings. As though the previously announced 27 technical papers were not enough, the final list showed these to be increased to no less than 32. The first day's sitting of the Congress began on Tuesday, and lasted from half-past nine in the morning till half-past nine in the evening, with only brief intervals for luncheon and dinner. Three sittings in one day, or nearly eight hours' actual work—there's an example for those who adjourn at two o'clock and do not hold an afternoon meeting! The Congress itself extended over four days, with further optional visits on Saturday. The first two days were devoted entirely to business and technical proceedings, while the last two were well occupied in visiting important gas and other works.

The hall of the French Institution of Civil Engineers, in Rue Blanche, Paris, was well filled with corporate members of the Society when the President, M. Deleury, announced the Congress to be opened; and a start was made with the business items on the programme. The first duty was the more or less formal one of electing the new members proposed. These numbered in all 38, consisting of one honorary member, styled on the list as "M. H. E. Jones, Esq., Président de the Institution of Gas Engineers;" 28 ordinary members, among whom was to be noted the name of Heer Bolsius, the well-known Manager of the Bois-le-Duc Gas-Works, Holland; and 9 associate members. All these were, of course, unanimously elected.

Committee's Report.

The President then read the annual report of the Committee. It opened, as is customary—unhappily and unavoidably so—with a list of deceased members. At the head of the twelve names was that of Mr. William Foulis, the graceful French tribute to whom we give in full.

> The reputation of Mr. W. Foulis as a gas engineer was universal. In England there were associated with his name important inventions which revolutionized the old methods of gas making. Among these can be cited the mechanical charging and drawing of retorts; the application to retort furnaces of the ideas of Siemens on heating and recuperation by waste heat; and the enrichment of coal gas by oil gas. William Foulis was born in 1838, at St. Andrews. He was the son of the gas-works manager in that town. After studying at the Glasgow University, he entered business, his first efforts being at the works of a locomotive builder at Hyde Park; then he entered the gas industry. In 1869, he was nominated Consulting Engineer to the Gas Department of Glasgow, to which he devoted his intelligence and his initiative during the last thirty years of his life. William Foulis died on June 29, 1903. He had been an honorary member of our Society since 1886. Our industry loses in him a fine engineer, an energetic worker, an advanced thinker; we ourselves lose a scientific and distinguished colleague.

Among other names were those of Mr. Eugene Vanderpool (of Newark, New Jersey), Herr Emile Lenz (of the Stettiner-Chamotte Fabrik), and M. Robert Hartmann (of Venice, and formerly of the Zurich and Metz Gas-Works). Though not attached to the Société Technique, reference was made to the loss of M. Arson, a past Chief Engineer of the Paris Gas Company.

The present numerical strength of the Society is 640—an increase of only four on last year's figures. There are 21 honorary, 508 full, and 111 associate members. The Committee's report then proceeds to mention the improvement that is being made with the library; and the early appearance of last year's volume of "Transactions" in October—three months sooner than usual—was favourably referred to. Similar rapidity is hoped for this year. Reference was then made to four pamphlets issued by the Society during the past twelve months; something of an explanation being offered for M. Mallet's review of gas progress, which was unfavourably noticed in the "Journal" at the time of its appearance. The other three exceptional publications were by M. Bouvier, M. Payet, and the report of the International Commission on Photometry (Zurich). Subscriptions from gas and other companies to the funds of the Society varied from 50 frs. to 2400 frs., amounting in all to 23,500 frs., or about £940. "In the renewed grants which have been made," the report concludes, "the Société Technique finds valuable encouragement to continue in the path of technical recording, on which it has resolutely entered this year."

Finances of the Society.

In the absence of M. Marquisan, the Treasurer's report was read by M. Visinet. It showed considerably increased expense compared with the previous year—largely due to the extra publications already referred to. The total receipts came to 53,974 frs. (£2159); but the expenses reached 66,792 frs. (£2671)—an excess of £512 in expenses over receipts. Notwithstanding this, the total capital of the Society has only decreased by £142, from 199,380 frs. (£7975), at the end of 1902, to 195,824 frs. (£7833) on Dec. 31, 1903. The largest item of expenditure is, of course, to be found under the heading "Publications," which this year cost 17,294 frs. (£692), compared with 12 416 frs. (£497) last year; while library expenses figure at 2649 frs. (£106), or more than double what they were the previous year. No less a sum than 10,331 frs. (£413) was disbursed by the Society in awards and prizes during the last twelve months. Its financial position is a strong one; and the report was adopted without comment.

Election of Office Bearers.

The voting for five members of the Committee was next taken. Four of the old members were retiring, but were eligible for re-election; and they were duly returned in the following order: M. Visinet, M. Brouardel, M. Gaston Gautier, and M. Villiers. Of the several names proposed to fill the fifth vacancy, M. Boutan (of Lyons) headed the list, and was placed on the Committee, a meeting of which was immediately called on the first adjournment of the congress. The officers for the year 1904-5 were afterwards announced. The popular M. Visinet, the Manager of St. Germain, was chosen as President, with M. Coze, as Vice-President. The Secretaries appointed were, as for the previous year, MM. Godinet and Thibaudet; and M. Marquisan, as usual, fills the *rôle* of Treasurer.

President's Address.

The first item of the first afternoon is always the presidential address. It does not perhaps fill such an important position with the French Society as the similar function does with the English Institution. Attention has been called on former occasions to the unsuitability of its position in the programme, as it is separated from the technical papers by the ceremony of distributing awards to workmen and others, and also by the reading of reports on prizes gained. The result is that the technical continuity of the proceedings, which should naturally be ushered in by the presidential address, is destroyed, and, as happened on this occasion, the President's remarks are subject to interruption by the arrival of the Government official to distribute the workmen's awards, as well as of the recipients themselves. All this would be avoided were such items to be taken first, followed by the remarks from the occupier of the presidential chair. This suggestion is offered for what it is worth.

M. Deleury, this year's President, is well known as an able engineer in the front rank of gas specialists, and head of an important undertaking—the Compagnie Générale Française et Continentale d'Eclairage—under whose control is the lighting of Moscow, besides several towns in France, such as Grasse, Amiens, Alençon, Carcassonne, &c. In his choice of a subject, M. Deleury wisely confined himself to his own experience at Moscow, as he rightly thought the conditions of gas supply in that city would be of interest. The greatest trouble is, of course, the cold; the tar in the pipes often freezing and completely blocking them. There is nothing special in the carbonizing plant; but naphtha is used for enrichment purposes. In spite of the low temperature, the mixed gas is very stable; the loss of illuminating power being insignificant. The lighting of the public lamps is costly, owing to the necessity for putting the gas-taps inside the lamps, on account of the cold. The incandescent burners and mantles work very well, notwithstanding temperatures of 30° C. to 35° C. below zero. M. Deleury then gave some very interesting details of the character and habits of the Russian labourers—their great docility, absolute impassiveness, devotion, and extreme ignorance, combined with religious superstition. The pay of skilled workmen seems extraordinarily low; being from 80c. to 1fr. 50c. per day of ten hours. Though apparently strong, the Russian workman, it is not surprising to learn, can offer but little resistance to hardship. He enjoys poor food and worse drinks, and gets along with the minimum of covering and comfort. After speaking of the friendly relations existing with the Government and the town officials, the President concluded his remarks by a reference to the political alliance of the two countries concerned, and said that "between the Russians and the French there was a real sympathy based on the community of many ideas and on a deep reciprocal regard."

Distribution of Awards.

As already mentioned, the President's address was interrupted by the entrance of the representative of the Minister of Commerce. In the latter's remarks, he pointed out that, though having nothing to do with political or religious subjects, the work of the Société Technique was not unconnected with social problems, and intimately concerned the well-being of workmen. He then read the list of the gas workers who had been awarded the Government medals.

M. Visinet followed with 35 names of workmen who, for their long and meritorious services, received prizes of 200 frs. (£8). This year also, for the first time, silver medals were distributed to old foremen and others, the length of whose service ranged from 30 to 49 years on the same gas-works. Awards of 250 frs. (£10) were made to the authors of the best papers contributed to last year's congress—viz., M. Chervet on "Technical Control in Small Works by a Pressure Register;" M. Guillet on "The Extraction of Cyanides from Gas;" and to M. Lecomte for his four papers on various subjects, it being remarked that "the Committee know full well the enthusiasm which M. Lecomte brings every year to making known and popular all apparatus, of whatever nature, intended to utilize gas."

A Gold Medal for M. De Brouwer.

The report on apparatus which has realized marked progress in the manufacture or utilization of gas was next read. After two or three details were mentioned, it was soon evident that the De Brouwer charger was the apparatus chosen for recognition and reward; and its inventor, who was present, received the Society's gold medal, amid the warm applause of his fellow-members. The report states that, without entering into discussion regarding inclined or horizontal retorts, "it is certain that the inventor of a machine so cheap, permitting horizontal retorts to be charged more quickly, and under better conditions, than by shovel or scoop, has realized important progress in the gas industry." The report goes on to add that: "The gas industry ought naturally to hold out the hand more and more to cause its workers to profit by the progress of science, and by the facilities which electricity gives from the point of view of actuating mechanical appliances." A description of a general carbonizing installation with the De Brouwer charger is then given. It being assumed that ten retort arches will be allotted to it, the cost would be as follows:—

	Francs.	Sterling.
Charger	7,000	£280
Elevator	10,000	400
Conveyor	20,300	812
Supports	3,700	148
Total	41,000	£1640

Other details given are—

Duration of making 400 kilos. (8 cwt.) charge	16 seconds.	
Duration of working of motor	34 ,,	
Energy absorbed during 1 hour of work	2·1750	K.W.H.
,, ,, ,, 34 seconds	0·0206	,,
,, required per ton $\frac{0·0206 \times 1000}{400}$ =	0·052	,,
,, ,, for 15 ton elevator and conveyor	0·289	,,
Total energy per ton	0·341	K.W.H.

The Committee's award to M. De Brouwer will, I think, be generally regarded as highly merited; and he richly deserved the hearty congratulations he received.

No award was made for essays offered in competition, nor among the five applications in connection with automatic lighting, though the Committee recorded their approval of the serious efforts that were being made in this direction. For æsthetic fittings for incandescent gas, both M. Ch. Blanc and M. Eug. Potron received silver medals, for five different forms of pendants and brackets for reversed burners. With the object of stimulating the use of the chief bye-product, the Committee decided to extend the award of 5000 frs. (£200) so as to include apparatus for utilizing coke. M. Pierson was a candidate, with his producer for poor gas for gas-engines or water gas; but, though the five days' experiments on it proved very successful—the gas made being very regular and its calorific power varying only from 1118 to 1179 per cubic metre—it was decided not to make any award. The report of the trials will appear in full in the Volume of "Transactions."

Reading of Papers.

All the preliminary business having been concluded just before four p.m., the way was clear to make a start with the papers. The 32 contributions on the programme might be roughly divided into four classes—dealing respectively with mechanical stoking, illumination, photometry, and miscellaneous subjects.

The first was a paper by M. Adolphe Bouvier, in whose absence it was summarized and read by M. Visinet. It described the Darmstadt Gas-Works, which were completed about two years ago. The works are arranged generally in three groups, each one being equal to a daily production of 25,000 cubic metres (882,500 cubic feet of gas. There are four benches of six arches of nine inclined retorts, 4 metres long (13 ft. 1½ in.). The author describes in sequence the coal-handling plant with Bradley tilting bucket conveyors; the sloping cellar coal-stores (Marshall system); the retort-house, coke conveyors, Beale exhausters, Pelouze and Audouin condenser, and Bueb naphthalene and cyanide washer, and so on. The general motive power is electricity, which also lights the purifier house, &c. The works belong to the Municipality; and from the drawings accompanying the paper, one would gather that they were very complete, if somewhat elaborate. There was no discussion on this descriptive paper; but M. Godinet made a few appropriate remarks. He said that, not having seen the Darmstadt works, he could not, of course, criticize them; but he drew attention to the mention of the Bradley conveyors and Marshall coal-stores, and wished to guard members against merely accepting these designations as though there were no other systems. He cited in favourable contrast the coal-stores at the Nanterre works (which members would have the opportunity of seeing), which had dispensed with the costly sloping bottoms of the Marshall stores at Darmstadt.

M. Parsy next read a short paper on a bench of eight beds of 20-feet inclined retorts recently completed at Nanterre Gas-Works. Difficulties in connection with the slipping of the French coal used are mentioned, and the means by which they were overcome are fully described—namely, the mixture of about 5 per cent. of small coke or breeze with the charge of coal. This matter has lately been noticed in the "Journal;" but in view of some recent remarks by a casual visitor to these works, the more extended and diametrically opposite observations of M. Parsy (and others) may be of some interest.* He says in the course of his paper: "The results [of this mixing of coke dust with the coal] were marvellous; not only did the charges no longer slip, but the coke itself, instead of being altered, came out from the retort perfectly compact and hard. The coke dust added to the coal is found incorporated in the mass with which it agglomerates. It is an actual regeneration of this bye-product." This would seem to confirm Mr. W. R. Herring's experience; and the differences in the evidence so far on this subject as regards Nanterre may possibly arise from the fact that where the coke dust, instead of becoming incorporated, was reported to have had the opposite effect of disintegrating the coke, the observer is said to have "looked at the mass with the microscope." However this may be, the facts as reported in M. Parsy's paper, and confirmed by M. L'Homme, the experienced Engineer and Manager of the works in question, are to the effect that a very successful installation of inclined retorts has been put up; that initiatory troubles with the slipping of powdery French coals have been entirely overcome by the admixture of coke dust and breeze, which at the same time becomes absorbed into the mass of coke; and the value of an otherwise poor residual greatly increased. A second paper by M. Parsy was "On the Decomposition of Hydrocarbons in the Retorts." He referred to the effect in this respect of the increasing practice of having through retorts for use with stoking machinery. His suggestion is to increase the thickness of the crown of the retorts, with the anticipated results of (1) reducing the carbon and increasing the life of the retort, (2) preventing stopped ascension-pipes, (3) increasing the make and lighting power, and (4) economy in fuel.

There not being any questions asked concerning these claims, the able and energetic Secretary of the Society—M. Payet—explained two of his contributions to the proceedings, both relating to the subject of photometry. The first was simply an attempt to establish a diagrammatic rule to facilitate certain photometrical operations; while the second sought to discover the means of removing, by photographic means, the human error—the personal equation—in testing illuminating power. After M. Verdier had passed some strictures on the former paper, and suggested certain supplementary corrections, accepted by the author, M. Jouanne, the well-known Editor of "Le Gaz," read his paper on dry-sealed purifiers. M. Jouanne evidently follows British gas practice pretty closely, for his paper was practically made up of a history of replacing hydraulic by rubber joints in England, with a description of some well-known examples. The author recalled to mind—a fact perhaps generally forgotten—that the first application of purifier dry-sealing dates from Mr. B. G. Venner's trials at the Eton Gas-Works in 1878; and M. Jouanne referred to a paper on this subject submitted to the Gas Institute in 1883. The round india-rubber joint then used was shown by a drawing. The "Eclipse" method of Messrs. Clapham Bros. was next described and illustrated; and the Preston and more recent Tynemouth purifiers also came in for mention. The cement-constructed purifiers at New Orleans and Toulon, by Mr. Shelton and M. Bachelay respectively, were not omitted. "In France," says M. Jouanne, "we know of only one example up to the present [of dry-sealed purifiers] which comes moreover from England, as it has just been put up by an English firm, the Whessoe Foundry Company, for the Compagnie l'Union des Gaz. As a visit to the Nanterre Gas-Works forms part of the programme of this congress, and as you will shortly see the purifiers in action, I will not enter into the details of their dry-sealed joints, the excellent arrangement of which you yourselves will appreciate."

Gas-engines formed the next subject for attention; and the familiar figure of M. Lecomte appeared at the reader's desk. His paper on "The Duplex Engine and the Use of Coke in Suction-Producers" was, as usual, full of detailed information of considerable interest and value. His conclusion is that the gas-engine, whether for small, moderate, or large powers, is now the fortunate rival of steam-engines of whatever improvement. M. Lecomte's fluency and volubility are so great that he is apt to forget the hands of the clock, and give his hearers credit for similar powers of endurance that he himself so happily possesses. The President had to remind him and the debaters of this, so as to allow M. Pierson to give before adjournment the results of some recent tests on a Crossley gas-engine at the electric light station of the Besançon Gas-Works. The tests recorded were very satisfactory; the gas consumption per effective horse-power-hour being 425 litres, against the guarantee of 480 litres.

* A translation of the paper will be found on p. 873.—Ed. J.G.L.

It was somewhat after six o'clock when the President adjourned the Tuesday afternoon sitting; but at half-past eight the same evening, members were again assembled. M. Foiret at once read his paper on the Simmance-Abady photometer; and this excellent little apparatus was handed round for examination, and was much admired. Its great utility and exactitude are well known in England; and therefore it needs no further description. As M. Foiret said, one of the principal advantages of this photometer is the rapidity and correctness it ensures, even by those who have not had any practical experience of photometry. M. Foiret's second paper dealt with the measurement of high temperatures; and he brought to notice a new pyrometer by M. Féry, sensitive and strong, which registered from 500° to 1000°C. Dr. Guglielminetti then delivered, in easy style and in a conversational manner, a lecture on the tarring of roads; his remarks being illustrated by interesting lantern slides of work done at Monte Carlo and elsewhere in the matter of dust-prevention and road-preserving. The long day's work was not even then over, for there were still the show-rooms of the Paris Gas Company to be visited; and many members profited by the opportunity of examining the numerous forms of fittings for gas lighting and heating.

A Morning with Stoking Machinery.

No less than five papers on the programme had reference to machinery for charging and drawing retorts; but as a matter of fact, six different machines were on Wednesday morning described and criticized. It will be better to notice them separately.

The De Brouwer Machines.—M. Laurain (of the Compagnie Continentale des Compteurs, &c., who have been appointed the Continental makers of the De Brouwer machines) opened the proceedings by describing the new pushing-machine which is now the companion of the Bruges charger. The principle of the discharger is already known, and the machine itself has previously been illustrated in the "Journal." Nothing more, therefore, need be said just now in this place; but it may be of interest to record the fact that before M. De Brouwer brought out the present winding pusher (if such a description may be allowed), a straight rigid-bar discharging machine was made, and has been satisfactorily working since Feb. 5 last on three beds of nine retorts about 13 feet long at the Barcelona Gas-Works. M. Laurain illustrated on the screen several examples—some actual and some imaginative; some good and some bad—of general arrangements for the "D. B." stoking-machines. A proposal, I believe of some novelty, was made—namely, to use the charging apparatus as a distributor of coal for the purpose of filling coal-stores. The machine was shown swung up in the roofing, and it would throw off the coal where required, as water from a fire-hose. Is such an arrangement practicable, and would damage to the coal result therefrom? M. Cornuault (Past-President) asked the author for definite figures regarding capital cost, amortization, depreciation, wear and tear, and labour, as these items were, he said, often ignored in any comparisons. M. Laurain rather demurred to giving such details in a public meeting, but merely generalized by saying that where the cost of labour per ton was about 3 frs. 50 c., a saving of between 70 and 75 per cent. would be made. In connection with the capital cost, he referred to the advisability of having but one ascension-pipe for a 20-feet retort; and he thought that no inconvenience would result therefrom, though the diameter of the pipe might be 8 inches instead of 7 inches.

On rising to join in the discussion, M. De Brouwer met with a hearty reception; and he occupied the attention of the meeting for some time. He was in favour of increasing the area of the ascension-pipes and hydraulic mains, and cited his former troubles with thick tar. He thought, however, that, "from all points of view, only one ascension-pipe was required, as, where there were two, only one pipe worked at one time." Was the gas made worse by travelling over 20 feet of retort? He considered that there was very little or nothing in it, though he significantly remarked that his gas was not generally examined for quality. With regard to wear and tear of the charging-machine, the band was the only part really subject to any considerable wear; and even this had been greatly reduced. He reckoned that a single band ought to deal with 15,000 tons of coal, which would work out at about 0·5 c. per ton. No difficulty whatever had been experienced in the working of the pusher, no breakdown of which need be feared, as the electric motor was the only part liable to failure, and this could easily be repaired. He pictured an ideal installation: Single producers for through beds, so that the coke could be discharged straight into them; overhead coal-hopper for three days' supply; and coke storage on the other side for six days' make. Needless to say, the members were keenly interested in the recital of M. De Brouwer's experiences and his recommendations.

The Paris Gas Company's Machines.—These electric turbine charging and discharging machines are made for abroad by Messrs. Sautter, Harlé, and Co.; and it was one of their representatives—M. Foillard—who read a paper describing them. It contained little or nothing previously unknown about them, but referred to the advantages that would accrue from a combined charging-discharging machine for small or medium-sized works. He said a large model combined machine would deal with 80 retorts, a medium one with 50 retorts, and a small type of machine with 30 retorts. There was no discussion on this paper; but M. Godinet raised incidentally the question of the advisability of thick or thin layers of coal to be carbonized. M. Euchène (of the Paris Gas Company) said that a thin layer of the same quantity would require less fuel—a statement which M. De Brouwer corroborated.

The *Oerlikon-Bertrand Machine.*—This is also an electrically-driven combined charging and pushing machine; the coal lying in a scoop on the top of the discharging ram. After the coke is cleared from the retorts the scoop is reversed, and the retort charged. Originality is claimed for the idea of using one and the same apparatus for both operations; and this, it is stated, considerably reduces both time and labour in stoking. Photographs of the machine accompanied the paper. [A reproduction of these, with a translation of the paper, appears on p. 872.]

Boutan's Charging-Machine at Lyons.—At the Villeurbanne Gas-Works (Lyons) this machine has been at work since the autumn of 1902; and the only accidents to it have been due to the failure of the electric current. The idea of the machine is to place the coal in a tube in two halves, which is then driven into the retort, the lower half withdrawn and the coal allowed to fall out. The tube is charged with coal from an overhead hopper—the tube being placed vertically or at an angle of 50°, so that it is automatically and entirely filled. In appearance, judging from the drawings and model exhibited, the Lyons machine resembles somewhat an Arrol-Foulis drawing-machine with a coal-hopper added. It has proved successful and strong, and is now being arranged to act also as a discharger, when it will be set to work on a bench of ten arches of nine retorts at the other Lyons works at Perrache.

Parsy's Elevator-Charger.—The previous machines had all been actually at work; but M. Parsy's elevator-charger was only a theoretical idea, though a model was shown by its author. It is called an elevator-charger because apparently there is no elevator. The coal is received from an independent skip at one end of the machine, and is thrown by a projector or drum on to an endless belt, from which it flies off into the retort to be charged. It will thus be seen that its origin is no doubt to be sought in the De Brouwer band, but that there are accessory modifications, in the direction in which English contractors are understood to be moving at the present time. It cannot, however, be said that the three tiers of glass retorts charged by M. Parsy's model showed much regularity in the layer of experimental coal. M. Salanson (Past-President) asked the pertinent question whether the apparatus was actually at work anywhere; to which M. Parsy replied in the negative, though a full-sized machine was being constructed. Then there arose a general discussion as to the power required for all these sorts and sizes of stoking machinery; and no very clear data were obtainable. Some degree of commercial antagonism was aroused among the partisans of one or other of the machines; but it was thought by one speaker that there was room for all types, according to the circumstances of each case.

Cabrier's Hand Charger.—This was a working model, similar to a machine in operation for some time past, and on a principle which was described in a paper presented by M. Cabrier to the Société Technique, at the meeting in 1901.* The coal falls from an overhead hopper into a drum which is turned by hand, and projects the coal into the retort very similarly to the De Brouwer machine. The experimental retort charged by M. Cabrier showed the coal to be very evenly distributed; and by varying the speed of turning the handle, a regular thin or thick layer could be obtained. M. Cabrier did not contribute any paper to the proceedings, but the working of his model was watched with great interest.

After the well-sustained attention on all these retort-stoking appliances for nearly three hours, it is not to be wondered at that the attendance dropped from about 200 to 20, and that M. Philippard had to be contented with so small an audience to hear his summary of his 36-page essay on the "Condensation of Solid and Liquid Particles in Gas."† The experiences he related, more particularly with regard to the American cyclone apparatus, were confirmed by two or three speakers; and M. Chevalet promised a paper on a kindred subject for next year.

The attendance of members dwindled still further away; and the President's adjournment was welcomed by the handful of survivors. It was felt by all that the main interest of this year's congress had been achieved in the full descriptions of the varieties of stoking machinery; and though some excitement was aroused at the afternoon sitting over a discussion between the venerable M. Louis Denayrouze and M. Lecomte, the papers were not of great importance; and I will therefore pass over them with mere mention.

The Remaining Papers.

The subject of meters was, as usual, referred to in two papers by M. Rouget—one on the "Simplex," form, by which the capacity of the drum can be doubled without interfering with the casing; and the other on a detail of the indicator gearing of wet meters. The Compagnie Continentale, through M. Lacaze, brought to notice a new dry meter, styled the "Constant." A joint paper by MM. Mallet (Past-President) and Payet, referred to the subject of the previous evening's lecture—the tarring of roads.

* See "Journal," Vol. LXXVIII., p. 393.

† A translation of the paper, with an illustration of the appliance described, will be found on p. 876.—Ed. J. G. L.

M. Denayrouze described some intensive burners; while M. Lecomte and M. Jouanne both showed examples of other incandescent specialities. The reversed burner of the Compagnie Générale d'Appareillage was shown by M. Sellié; and systems of automatic lighting of public lamps were dealt with by M. Fritz and M. Casaubon. An apparatus for intermittent advertisement illumination by gas was mentioned by M. Ménagé; and M. Th. Vautier (Past-President), who was not present, contributed a paper on the photometry of a reversed flame. In conclusion, MM. Godinet and Payet gave particulars of the official report on a coke producer submitted in competition; a movable apparatus for pumping out syphons was detailed by M. Delatte; and, in a brief note, means for encouraging the use of gas for domestic purposes were considered by M. Garnier. So was concluded the reading of the 32 papers submitted to the Paris Congress of 1904, and the President announced the final adjournment.

Visits to Works.

Two of the visits arranged for the congress this year may be considered as of peculiar importance—that made on Thursday morning to the gas-works at La Villette, which are already personally familiar to many English engineers, and to all through the descriptions given in the "JOURNAL" of the Paris Gas Company's charging and discharging machines, and that on Friday afternoon to the new works at Nanterre of the Compagnie l'Union des Gaz. Both of these visits were largely attended, and they deserve separate notice.

La Villette.—At La Villette works, the electric turbine charger and pusher were seen in operation on one of the several parallel benches of eight beds of seven retorts, of which the carbonizing plant is made up. There were no two opinions as to the excellent character of the work done; heavy charges of 450 kilos. (9 cwt.) being regularly laid and thoroughly well carbonized. The discharging also left nothing to be desired; the pusher admirably clearing the retorts of their coke. This was received into large hoppers on wheels moved along by two men to the quenching arrangement outside. A novelty was shown in the shape of a movable "waterfall" elevator, which is being tried more or less experimentally. It consists of a large wide water-trough into which the coke falls on being pushed out of the retort. A series of angle-iron steps forms the elevator, down which water continuously runs as in a cascade, and up which the coke is carried. At the top, the coke is thrown down a wide shoot into a steel waggon, which runs on the railway system of the works. A large hood covers the elevator, and acts as a flue to carry off the steam up towards the roof. The whole is actuated by an electric motor. It will be understood that the receiving elevator is placed on the same longitudinal line of the retort to be discharged, and that the movement of the coke parallel to the bench is effected by the truck into which the quenched coke is delivered. The stoking machinery and this hot-coke elevator formed the main objects of the visit; and the thanks of the members of the Society to the Directors of the Company were suitably expressed by M. Deleury, who commented in particular upon the originality of the coke-quenching elevator.

On the afternoon of Thursday, a special train took members and their lady friends to the large and well-known chocolate manufactory of MM. Menier Frères, at Noisiel. The order and cleanliness, the modern machinery and its variety, the gas-producers, works, and motors, all employed in the make and expedition of 55 tons of chocolate per day, were greatly admired and proved full of interest. The next morning a visit was paid to the works of the Paris Metropolitan Railway, at the Quai d'Austerlitz, which offered a pleasing note of variety, and was full of instruction for members of a gas society.

Nanterre Works.—These works of the Compagnie l'Union des Gaz, with which is affiliated the Continental Union Gas Company, Limited, have for some time past excited considerable interest and attention, so much so that there have been almost daily both technical and non-technical visitors from all parts of Europe to see them. Needless to say, therefore, a visit on Friday afternoon by members of the Société Technique was a natural and obvious item for inclusion in their Paris Congress programme. The visit attracted a large number of prominent engineers, including several from the Paris Gas Company, besides others intimately associated with the gas affairs of the French capital. As on the previous day the stoking machines of La Villette had been on show, so here at Nanterre an opportunity was afforded of comparison with an inclined retort plant, and other ancillary apparatus of a very up-to-date kind. On arriving at the works soon after two o'clock, the members were cordially received by M. Salanson, the President in Paris of the Union des Gaz, and other Directors, who were accompanied by the Secretary, M. De Savignac, and, of course, by the able Engineer and Manager of the works, M. Paul L'Homme. The fine site on the banks of the Seine was at once the cause of favourable comment, not only for its situation and shape, but also for its extent and ample provision for the future. Being situated so near Paris, it was obviously only common prudence to look well ahead, where the gas requirements of so many and increasingly important suburbs of the second city in the world have to be considered. The river side was then reached, and a Hone's grab, worked from an overhead crane, was evidently a novelty to a great many present. There being at the time no boat alongside the quay, coal was lifted from an adjacent heap, and thrown into one of the two hoppers for conveyance into the coal-stores, which run in two bays longitudinally from the river. Starting from the hoppers, the coal plant is in duplicate throughout; each set consisting of breaker, automatic weigher, elevator, overhead push-plate conveyor, for filling the stores, outlet doors and jigging feeders for supplying the underground steel-plate conveyor for carrying the coal from the stores to the elevators serving the retort-house. Of course, if desired, the coal can be taken from the barge, and carried direct to the retort-house, without being deposited in the stores. Or, on the other hand, any particular coal from any part of the two coal-store bays can be taken automatically by the subway conveyors. Thus any desired mixture of different coals can be easily and immediately obtained. After these explanations had been given to the visitors, and the cheapness of construction noted, through dispensing with the usual hopper-bottomed stores (to which M. Godinet had drawn attention in his remarks on M. Bouvier's paper on the Darmstadt Gas-Works), admiration was expressed at the completeness of the whole plant. Here at Nanterre the coal itself is allowed to form its natural angle of repose, and so save the expense of any artifically constructed sloping sides. The variety of simple combinations and conveniences possible with the coal plant as arranged was acknowledged to be of great advantage, and unique among the gas-works of France.

Having seen the satisfactory working of the coal conveyors and elevators, the next move was to the retort-house, where there are sloping retorts only recently started. As this installation is described in the paper contributed by M. Parsy to the proceedings of the congress [see p. 873] no observations are needed here, except briefly to record some facts and impressions. The visitors went to the top of the retorts, and remarked the simplicity of the effective charging apparatus (which is of quite a new design), and the good heating of the retorts. A little lower down, the heating—something between clear cherry red and deep orange—was also satisfactory; and the bottom half of the retorts was also deep to clear orange. The general impression, as expressed by several carbonizing engineers, was that the retorts were heating very well; and convincing proof of this was to be seen by all in the thoroughly burnt-off charges that shot down from the 20-feet retorts. There was no sign whatever of any slipping; and the Manager stated that the mixing of the coke breeze had entirely overcome this difficulty, and at the same time reduced the quantity of coke dust. He was asked what was the average charge put into each retort; and the answer was "340 kilos." (nearly 7 cwt.). It was afterwards learnt that the coke used for heating the settings was only $13\frac{1}{2}$ per cent. of the coal carbonized; and it was hoped to reduce even this proportion in the near future. Much detailed interest was shown in the performance of the new patent hot-coke conveyor, which it was admitted on all hands was doing its work remarkably well. "Silent, steady, strong, and practical," would sum up the observations overheard; while the easy regulation of the quenching, thus avoiding discoloration of the coke, and the advantages of steam exhaustion, did not pass unnoticed. The screens for cold coke, the hoppers, and the yard storing conveyors were examined; and the hectolitre ($2\frac{3}{4}$ bushels) measurers were at work filling sacks. The proposed arrangement for general future extensions was explained by the aid of a small plan distributed among the visitors; and it was seen that eventually it would be possible for all the operations between receiving coal by river and sending away coke by the same way to be effected entirely by mechanical means.

Walking across from the retort-house to the machinery building, it was remarked by some that the unfinished state of the ground and roads—the levelling of the site not yet being completed, and the flooring generally unbegun—did not tend to show off to the best advantage the excellent plant and machinery that had been put up. But these undoubtedly just comments were due to special circumstances; and, as with all new works on an extended area, certain allowances must of necessity be made within the first few weeks of starting in action apparatus of an entirely unfamiliar character. Passing on to the purifier plant, this was immediately described by several as a "fine installation," consisting as it does of eight overhead boxes, each 25 feet square by 5 feet deep, and arranged in two lines of four's. Particular attention was given to the dry-sealing of the purifier flat covers, as M. Jouanne had previously mentioned it in his paper. Its great advantage over water-luting was acknowledged; while the constructional work alike of the column supports, staging, and boxes was characterized as of excellent quality. It was explained to inquirers that there were at present no gasholders at Nanterre, as the old Rueil Gas-Works, some two miles distant—now closed as far as manufacturing was concerned—were used for gas storage and distributing purposes.

As time was quickly passing, and the new works had been closely inspected, refreshments were served in the station-meter room, and M. Salanson expressed the Company's pleasure in welcoming the members of the Society, and said he hoped that they had been interested in what they had seen. The applause which greeted his remarks was amply sufficient evidence of the satisfaction given, which, however, M. Deleury put into suitable words of thanks and appreciation. After a full three hours' visit to these modern and most interesting works, illustrating as they do the practicability of reducing to a minimum manual operations in a medium-sized gas-works (it was said that only 25 men

in all were employed, and certainly the men were generally conspicuous by their absence), the members separated, and the last item of the Society's yearly programme was concluded.

Before writing "Finis" to this review, I must not forget to mention the successful banquet held on Wednesday evening, at the Restaurant du Palais d'Orsay. Many were the gas notabilities present, Vice-Presidents abounded, and the Paris Gas Company was well represented. Interesting speeches were made by M. Deleury, M. Cornuault (as the oldest Vice-President), and by M. Bertrand (of the Paris Company). M. Visinet, as the President-Elect, and since Friday evening the President, of the Society, proposed the health of M. Deleury, which was supported by M. André Coze, as the Vice-President. For the purpose of identifying members attending the congress and the visits in connection therewith, the idea was carried out of presenting a special button to each; and a distinguishing mark of very pleasing design and neat execution it proved to be. Some conception of it can be obtained from the accompanying illustration.

Whatever may be in store for the next year's congress at Havre (where M. Gaston Gautier is the Manager of the European Gas Company's works), it certainly may be hoped that it will be as full, profitable, and successful as the one at Paris in 1904.

FRENCH ENGINEERS AND STOKING MACHINERY.

Owing to the less favourable conditions on which concessions have lately been renewed in France, the attention of gas engineers and managers has been very keenly directed to methods whereby economy may be effected in the cost of production. Heavy charges, hitherto unknown, have been put upon them; while their raw material keeps at prices which give rise to not a little anxiety. Unfortunately, there are no items of revenue which adequately compensate for these additional burdens—unreasonable reductions in price having been imposed with the renewal of the concessions. Economy has, therefore, to be effected somewhere. Of the three principal factors governing the net cost of gas—the price of the raw material, its complete utilization, and the labour employed therein—the first it is out of the power of gas managers to control. With regard to the second, there has been so great an advance in methods of carbonization, that there is little hope of extracting much more gas from the coal than is done at present. There remains, then, the third factor; and it is to economy in the work of the retort-house that the manager must look for reducing his expenses. At present, labour in this department works out to from 2 frs. 50 c. to 3 frs. 75 c. and even 4 frs. per ton of coal carbonized. This fact lent special interest to the subject of the substitution of machinery for hand labour in the charging and drawing of retorts, which was brought forward at the meeting held last week of the Société Technique du Gaz en France in several papers, two of which are noticed below.

Probably the more important of the communications referred to was that of M. Foillard, who gave the members a good description of the Paris Gas Company's electric turbine charging and discharging machine, of which a full account was published in the "Journal" for the 19th of May last year. As was then mentioned, the British and Colonial rights in the invention have been secured by Mr. F. D. Marshall; and the machine is being made by the Whessoe Foundry Company, Limited, of Darlington, who have erected one at Beckton, an illustration of which was circulated with our issue last week. M. Foillard did not add much to what has been made known through these columns in regard to the machine; but he offered a few observations on the duration of the period of distillation. As the outcome of a number of experiments, it has been found that the retorts in general use by the Paris Gas Company, which are 25 inch by 14 inch and 20 feet long, gave the best results with charges of about 8¾ cwt. of coal worked off in six hours. With special retorts, however, one could go further than this, in respect of both the weight and duration of the charge.

The author added a few remarks on the advantages of mechanical stoking. The chief of these is, of course, the reduction in the cost of labour; but it is supplemented by an increase in the productive power of the bench. The saving realized necessarily varies with the conditions of working and the types of machines employed; but it is always substantial. In the case of an initial application, it may be reckoned at about 60 per cent. With hand stoking, the charge depends in a large measure upon the strength of the men employed; and in warm countries this is materially affected by the prevailing temperature. With mechanical stoking, the weight of the charge can, of course, be determined by the requirements of the business, irrespective of weather. The author gave as an example the works at Rio de Janeiro, where the settings have 10-feet retorts of the kind used by the Paris Gas Company, which are ⌂ shaped, but with the bottom slightly dished. They are worked with four-hour charges of about 1¾ cwt. only, which corresponds to 10½ cwt. in 24 hours. As already shown, with mechanical charging, 8¾ cwt. of coal can be carbonized in a 20-feet retort, or close upon 4½ cwt. in one of 10 feet. This gives for a six-hour charge 17¾ cwt. instead of 10½ cwt. per retort per 24 hours. The productive power of the bench is consequently almost double. Mechanical stoking, therefore, not only enables a manager to get more out of his works if needed, but to produce his present quantity of gas with a smaller number of settings under fire. These, the author pointed out, in conclusion, are important advantages, especially when it is borne in mind that they can be attained by means of a system which is applicable in all works where horizontal retorts are in use, without necessitating any other alterations in the retort-house than a line of rails upon the ground and a wire wherewith to obtain a supply of electricity.

The other paper was by M. Laurain, who supplemented the particulars which he gave at the congress at Toulon last year in regard to the De Brouwer charger, by others concerning the discharger, which completes the system. Almost simultaneously with the presentation of these details to the French engineers assembled in Paris, Mr. J. Ferguson Bell was describing to his colleagues at Westminster the installation of M. De Brouwer's machinery which he has put up at Derby, an account of which was given in the "Journal" last week. M. Laurain fully explained the machine in its complete form, and gave a description of a typical bench of retorts which the French Company who make the machine (the Compagnie Continentale) have arranged with the firm of MM. De Lachomette, Villiers, and Co., so as to utilize it and the various auxiliary appliances to the best advantage. It consists of seven settings of nine retorts 20 feet long. Allowing for one-seventh of the total number of retorts being held in reserve, this gives an effective productive capacity of 54 retorts. Assuming that work is done under the most unfavourable conditions, and that only 2 metric tons of coal per retort are carbonized per 24 hours, the weight to be dealt with per day would be 108 metric tons, producing in round numbers 30,000 cubic metres, or rather more than a million cubic feet, of gas. This bench would correspond to a carbonization of 25,000 tons of coal per annum, and would represent the retort-house of works producing annually from 250 to 280 million cubic feet of gas. For works requiring to send out 500 million cubic feet per annum, the makers prefer to have two benches of retorts, in which case the breaking, screening, and mechanical storage of the coke is common to both. For works producing from 700 to 800 million cubic feet, they advise three typical benches. And, finally, for 1000 million cubic feet, they propose four benches, with an installation of coke-handling plant for each pair of benches. Illustrations of these arrangements accompanied M. Laurain's paper, which with the one noticed above, furnished information on what is to every gas manager a specially interesting subject.

THE GAS AND WATER STOCK MARKET.

(For Stock and Share List, see p. 897.)

The general outlook of affairs on the Stock Exchange did not improve last week. Everything persisted in remaining quite quiet, and defied every effort to galvanize it into any degree of activity. The tone on the whole was dull, though now and then a brighter ray temporarily relieved the gloom. The closing of the Exchange on Saturday, too, did not tend to make things more lively; and the prospect of the counter attractions in the world of sport this week does not promise to render business more lively yet awhile. In the Money Market, there was a fair demand early in the week; but it eased off considerably later on, and closed without further change. A question giving rise to much speculation was as to how the Water Companies' stockholders are to be paid—whether in stock or cash. If the parties should be unable to agree on a price at which stock shall be taken, then the only alternative is cash; and the provision of the large amount required in that case might be a formidable affair. Business in the Gas Market was rather more active than it had been the week before, though in the first day or two it did not get into full swing. There were very few changes in quotations; and a nice steady tendency was the prevailing characteristic. The Board of Trade Committee's report, which agitates professional circles, has, of course, not reached the market. If it had, the market would not regard it—and perhaps the market would be right. In Gaslight and Coke issues, the ordinary opened quiet but firmer, and soon became active, with a rather better tendency. The figures at which transactions were marked ranged from 92¼ to 93⅜, several parcels changing hands at the latter price. The secured issues were little dealt in, and were unchanged. South Metropolitan was steady, prices being within the limits of 124½-126½. The only business done in Commercials was a couple of bargains taken at "special" prices. There was nothing at all to note in connection with the Suburban and Provincial group on the London Market; but Newcastle advanced on the local Exchange. The Continental Companies were mostly quiet. European and Imperial were firm; but in Union, the ordinary advanced and the preference receded. In the undertakings of the remoter world, there was nothing much to remark. In the Water Companies, there was a fair amount of business,

notwithstanding the near approach of the "appointed day;" and two or three issues improved in quotation.

The daily operations were: Monday was firm, but quiet. Gaslight ordinary rose 1. In Water, New River advanced 5, West Middlesex 1½, and Southwark 1. Business improved in volume on Tuesday, Wednesday, and Thursday; and prices were steady without any change in quotations. Friday was active. Union fell 1½; but ditto preference advanced 2. The Exchange was closed on Saturday.

ELECTRIC LIGHTING MEMORANDA.

The Cost of Electricity Generating Stations—A Lesson in Municipal Demeanour—A Gas Power Station—A New Arc Lamp.

SEVERAL instructive papers have been published lately, giving the cost of electric power stations; and it is very remarkable how largely the capital expenditure of most local authorities who have gone into this business exceeds the engineering estimates. It is interesting to look into the reasons given for the difference. Mr. G. L. Addenbrooke is the latest witness on this side; his testimony being in the form of an article in "Engineering." He shows that the cost of electricity generating stations varies with their size; so that, whereas for a plant of the largest size, with the necessary reserves, the cost per kilowatt of output should be less than £30, it may be £44 for a plant of only 500 kilowatts capacity. These estimates are exclusive of the distributing system or transformers. They are stated to be based on works completed, or else on tenders; and they include all requisite buildings, chimney, foundations, and conveyor accessories in the larger sizes. These generating plants are really steam-generating stations with dynamos attached to the engines, and a switchboard for distributing the current. It is usual to think of them as electric stations, and most people imagine them to be full of electrical plant; but this is a very great misapprehension. So far as the works aspect of the business is concerned, the electric part of the plant is a minor consideration. It is Mr. Addenbrooke's case that the economy of capital cost and working expenses in a large central establishment is such as to enable it to distribute power over (say) a radius of eight miles at a lower charge than it can be supplied on the spot in small units, even up to 400 or 500 horse power. It appears, however, that the central station will have to find customers for at least 10,000 kilowatts in order to realize these advantages. The utmost economy looked for by using gas instead of steam at the central station is about 10 per cent. in the supply price during ordinary working hours. For very long-hour custom, the economy would be greater from gas-power stations. It is significant that the author looks to overhead transmission for assistance in making power-in-bulk undertakings remunerative. This confirms the prevailing impression that the present underground transmission is killing the business.

A remarkable sidelight on municipal enterprise in practice, as compared with the theoretical aspect of it which is usually described in British Association papers and newspaper articles, is given by an electrical contemporary as news emanating from West Bromwich. Fourteen of the employees of the Corporation Electricity Department recently petitioned the Committee with reference to the peculiar notions of his public duties entertained by one of their number, an Alderman, who appears to have regarded himself as master of the establishment. It was complained that he was in the habit of haunting the works, with the result that all discipline was destroyed, inasmuch as certain of the workmen seemed to think that with his influence at their backs they could do as they liked. The most satisfactory part of this intelligence is the sequel. The employees' petition was considered at a special meeting of the Committee convened for the purpose, when the member complained of owned to the impeachment of interfering, apologized, and promised to keep away for the future—except, of course, on official occasions. Our contemporary, which has some knowledge of manners and customs of trading muncipalities, rapturously applauds this termination of a vexatious business, and expects in consequence "a hurricane of similar petitions from the harassed municipal staffs all over the country." This is one of those comments which, as the French say, "give furiously to think." Gas-works under municipal control, no less than electricity works, know the type of that Alderman. It has very often to be brought somehow to the comprehension of members of corporation committees that they are not, personally and individually, the masters of the working staff of the municipality, but are no better than strangers on the works, unless on official duty, or being personally conducted by the manager or his representative.

An interesting addition to the number of gas-power electric lighting stations has just been opened at Faversham, and is described in detail in the current number of the "Electrician." The power gas is made by Dowson producers, which with the boiler are housed in the coal-shed. The boiler is fired with coke and the producers with anthracite peas, which cost 26s. per ton on the spot. Coke is, of course, considerably cheaper; so that the circumstance of the more costly anthracite coal being preferred for the gas producers is of much significance. The gas as made is first of all trapped through a hydraulic seal, where any tar is expected to settle. Next it passes through a coke scrubber, wet; and then through a sawdust purifier, which has to be changed every three weeks or so. There is likewise a gasholder, to act as relief; but the producers can also be connected directly with the engines. It will thus be observed that the power plant is a very good imitation of an ordinary gas-works. The gas-engines are Westinghouse, three cylinder, 85 brake horse power at 290 revolutions, with electric ignition. Starting is done by compressed air, which is stored for the purpose in reservoirs at 200 lbs. pressure. The dynamos are of Westinghouse make. There is a storage battery of 250 cells. The total cost of the scheme amounts to £16,500. Its working should furnish some interesting data for comparison with other systems.

It is very significant that a vast amount of pains is being incessantly exercised on the improvement of the electric arc lamp, which is a competitor for public street and other high-power lighting entitled to the unwavering respect of gas engineers. The familiar patterns of the arc lamp, whether the open, enclosed, or flaming type, are sufficiently well known in the light market; and their characteristics are fairly appraised. It is true that the carbon arc lamp has held the field against all other makes, notwithstanding the facts that the amount of attendance required neutralizes their economy of current per unit of light produced, and that the light is unmanageably intense. Where the "flame" effect is added to the operation of the carbon arc, the quantity of smoke or dust produced is considerable, and the labour of attendance is greatly increased. One of the latest attempts to make a really improved arc lamp is the outcome of much research on the part of the General Electric Company of America; and magnetite, or the black oxide of iron, is used as the substitute for carbon rods. The investigations of the Company into the mechanism of the arc light have indicated that the substance, whatever it is, which is the vehicle of the arc flame, proceeds from the negative terminal as a high velocity blast, which produces heat on striking the positive terminal. If therefore this terminal cannot conduct the heat away, it may become hotter than the negative; and it actually does so in the case of the carbon arc. If the positive terminal is large enough, and is a sufficiently good conductor of heat, it will not wear away; but the negative terminal will shatter itself against it. Make the positive of copper, and of such scantling as to get hot enough but not too hot, and make the wearing terminal of magnetite, and the result is, as reported, a steady, white arc light of such a life that the lamp will only require attention about as often as an incandescent electric lamp needs renewal—that is to say, about every 500 or 600 hours. The light does not come from the terminals, but entirely from the arc flame, which is stated to be maintainable at constant length by simple positive mechanism. It is apparently claimed that the lamp has a higher efficiency than the carbon arc, imasmuch as it does not depend on the utilization of heat as an intermediary stage of the transformation of electric energy into light. Be this as it may—and the mechanism of the transformation in the case is not at all clear—the more important consideration for practical purposes is the alleged reduction of the labour of trimming. If this claim can be sustained, and the quantity of light is manageable, there should be room in the market for the magnetite lamp. One has heard so often, however, that the perfect arc lamp has come at last, that it is desirable to take with reserve all reports to this effect.

THE LATE GENERAL HICKENLOOPER.

IN the "JOURNAL" a fortnight ago, we gave a few particulars of the life-work of General Hickenlooper, whose death on the 12th ult. we then regretfully recorded. As the deceased was probably a unique example of a man who combined the qualities of a military as well as a civil engineer, it may not be uninteresting to supplement our brief reference to the latter part of his career by a few facts taken from a full obituary notice in the current number of "Progressive Age."

After the close of the Civil War, and upon being mustered out of service, the War Board of Honour awarded General Hickenlooper a gold medal, bearing the inscription: "Pittsburg Landing, Siege of Corinth, Iuka, Corinth, Port Gibson, Raymond, Jackson, Champion Hill, Vicksburg;" and Generals Logan, Howard, Sherman, and Grant recommended that he should be appointed Major of Artillery in the regular army or for the office of United States Marshal for the Southern District of Ohio. His appointment to the latter position was confirmed in 1866. He served until January, 1871, when he tendered his resignation, to accept an appointment as City Civil Engineer. This office he resigned in May, 1872, to become Vice-President of the Cincinnati Gaslight and Coke Company.

In addition to General Hickenlooper's connection with the American Gaslight Association, alluded to in our previous notice, he was elected a member of the Ohio Gaslight Association on Sept. 17, 1884. He was the first honorary member, and filled the office of President during 1884, 1885, and 1886. Among the papers he wrote, one was on "Municipalities *versus* Gas Companies" and another on "Street Lighting." He was always welcome at Association meetings, and had a pleasant word to say when called on. The success with which he kept natural gas out of Cincinnati, and for years held the street lighting, will go down to posterity as an achievement.

THE INSTITUTION OF GAS ENGINEERS.

PROCEEDINGS AT THE SECOND ANNUAL GENERAL MEETING

HELD AT THE

INSTITUTION OF MECHANICAL ENGINEERS, WESTMINSTER, S.W.,

JUNE 7, 8, and 9, 1904.

MR. H. E. JONES, M.INST.C.E., PRESIDENT, IN THE CHAIR.

PAPERS READ.

THE FLOW OF GAS IN MAINS AND DISTRIBUTION AT HIGH PRESSURE.

By W. C. UNWIN, M.Inst.C.E., F.R.S.

Some explanation is required in presenting a paper to the Institution of Gas Engineers, seeing that the author is not practically acquainted with the gas industry. The President is, however, partly responsible. He suggested that distribution at high pressure was a pressing question among gas engineers at the present time, and that a re-examination of the problem of the flow of gas in pipes would be useful. The author has given much attention to questions of this kind; and it may be said that the treatment of problems of the flow of gas in text-books appears to him to be rather crude and vague.

In ordinary practice at present, gas is conveyed in mains under very small differences of pressure—that is, usually less than 2 inches of water column per mile of main.* Consequently the velocity of flow is small—probably ordinarily in large mains about 15 feet per second. The mains are much larger than they would be if the velocity of flow permitted was greater. In no other instance known to the author are light fluids conveyed in pipes at such low velocities. In the case of a heavy fluid—such as water, which is about 1200 times as heavy as gas—the velocity of flow must be restricted, partly to limit the frictional losses, partly to diminish shocks due to inertia. But with light fluids, no such restriction is necessary. Natural gas, compressed air, and steam, have been transmitted in pipes at a velocity of 100 feet or more per second.

It may be admitted that long and extensive experience has sanctioned, in the case of lighting gas, the present practice, which involves the use of large and costly mains. But the causes which led to this practice may no longer be so important as they were in the earlier days of the gas industry; or at any rate there may be cases where transmission in smaller mains at higher velocities may be more advantageous. There seems to be reason at the present time for reconsidering this question, since one or two gas engineers have already departed boldly from the ordinary practice.

No doubt fifty years ago the jointing of gas-mains was imperfect, and the risk of increasing leakage by increase of pressure was very serious; and, further, distribution at low pressure was convenient from its simplicity and the absence of compressing and pressure-regulating apparatus. But it is surprising that a compound system of primary distributing mains at high pressure, delivering into secondary service systems at low pressure, seems not to have been considered till recently. The percentage of unaccounted-for gas is still rather large. But there appear to be two opinions as to how far this is due to leakage of the mains; and conclusive experiments on the amount of leakage seem to be wanting. But leakage is exactly such a difficulty as engineers should be able to overcome.

At the present time, compressing and pressure regulating machinery is well understood; and the leakage difficulty may be assumed to be not insuperable. There is now evidence that gas can be distributed at really high pressures in comparatively small mains without serious practical difficulty, and with considerable economy of cost. The experience of Mr. Shelton, of Philadelphia, of Mr. George Helps, of Nuneaton, and of Mr. Charles Carpenter, of the South Metropolitan Gas Company, appears to be conclusive as to this. But then the laws of the flow of gas in mains require some reconsideration. Gas engineers will have to calculate the friction in mains as hydraulic engineers have to do. One new development, which makes it opportune to examine these questions again, is the system of distributing producer gas for power purposes over considerable districts, which appears likely to be very important in the near future. In this case, economy in the distributing mains will be more important even than in the case of lighting gas.

Resistance to Flow in Mains.—If the statements in such books as Clegg's "Gas Manufacture" may be taken as evidence, gas engineers have hitherto required only rough estimates of the frictional resistance of gas-mains. The small differences of pressure required in the present system of distribution are so well within command without alteration of apparatus, that gas engineers appear to rely on experience without much troubling themselves with calculation. About the year 1851, the late Dr. William Pole published a formula for the flow in mains, which is an obvious modification of a well-known hydraulic formula. From this, Mr. Thomas Greaves Barlow calculated some tables of the discharge of different mains under various pressures, which seem to have served the purposes of the gas engineer to the present time. No doubt Dr. Pole's formula, although empirical, is an approximately true expression for the resistance to the flow of gas in pipes in average circumstances. But it undoubtedly requires modification in different cases.

Gas Pressure.—In ordinary statements as to gas pressure, what is given is the excess of gas pressure over atmospheric pressure. The real or absolute pressure is the so-stated gas pressure *plus* the barometric pressure at the time and place considered. In the present paper, the pressures will be measured in feet of water, and the average barometric pressure will be taken at 34 feet of water. Hence, if p is the pressure as ordinarily stated in feet of water, $p + 34$ is the absolute pressure.

Flow of Water in Pipes.—The flow of water in pipes has been the subject of a very large number of experiments, and is for practical purposes well understood. The difference of pressure at two ends of a main through which water is flowing is commonly termed the head lost in friction.

Let Q = volume discharged in cubic feet per second.
v = velocity in feet per second.
l = length of main in feet.
d = diameter of pipe in feet.
h = head lost in feet of water.
G_w = weight of one cubic foot of water in lbs. ($G_w = 62{\cdot}4$ nearly.)

Let A B (fig. 1) represent the part of the main considered. If any horizontal datum line X X is taken, the elevations, Z_1 Z_2, at A and B will in general be different. Suppose vertical pipes introduced at A and B, the water will rise in these to heights p_1/G_w and p_2/G_w proportioned to the pressures at A and B. The line C D through the pressure column tops is termed the line of hydraulic gradient. The difference of level of the pressure columns

$$h = \frac{p_1 - p_2}{G_w} + z_1 - z_2 \quad \cdot \cdot \quad (1)$$

* In books, and even scientific papers, it is common to say that gas is distributed at so many inches pressure without any reference to the length of main. This is completely indefinite. The difference of the pressure per mile is definite; and the discharge depends on this directly.

is the head lost in friction in the length l. In hydraulic questions the difference of atmospheric pressure at C and D is, in practical calculations, treated as negligible. Then the relations between the discharge, velocity, head lost, and size of main are given by the following equations:—

$$\left.\begin{aligned} \zeta \frac{V^2}{2g} &= \frac{d}{4} \cdot \frac{h}{l} \\ v &= \sqrt{\left\{\frac{2gdh}{4\zeta l}\right\}} = 4{\cdot}012\sqrt{\frac{d\,h}{\zeta l}} \\ h &= \zeta \frac{v^2}{2g} \cdot \frac{4\,l}{d} = 0{\cdot}0622\frac{\zeta v^2 l}{d} \\ Q &= \frac{\pi}{4} d^2 v = 3{\cdot}151\, d^2\sqrt{\frac{d\,h}{\zeta\, l}} \\ d &= 0{\cdot}632 \sqrt[5]{\frac{Q^2 \zeta\, l}{h}} \end{aligned}\right\} \quad (2)$$

The factor ζ in these equations, generally termed the coefficient of friction, is known to vary (1) with the roughness of the surface of the pipe; (2) with the diameter of the pipe; and (3) in a smaller degree with the velocity of the water.

Neglecting the last cause of variation, it is sufficient for practical calculations to take

$$\zeta = 0{\cdot}005 \text{ to } 0{\cdot}01\left(1 + \frac{1}{12d}\right) \quad . \quad . \quad . \quad (3)$$

according as the pipe is new and smooth, or old and incrusted with deposit.

Flow of Gas in Pipes.—The above equations apply exactly to the flow of gas in pipes so long as the variations of pressure are not great enough to cause important changes of volume. If, for instance, the absolute pressures at the ends of a main are 34½ and 34 feet of water, the expansion of the gas is only about 1½ per cent.; and this in calculations of this kind is generally negligible. If the variation of pressure is considerable, then the work done by the expansion of the gas must be taken into the reckoning, and the equations (2) are not exact. In using the equations (2) for gas, it must be remembered that h must be estimated in feet of gas, as will be indicated presently.

The equation of Dr. Pole

$$Q = 1350\, d^2\sqrt{\frac{h\,d}{s\,l}} \quad . \quad . \quad . \quad (4)$$

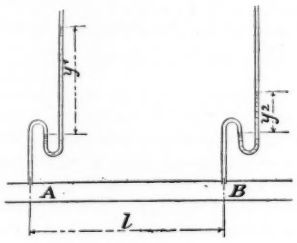


FIG. 2.

HEAD LOST IN HORIZONTAL GAS-MAINS.

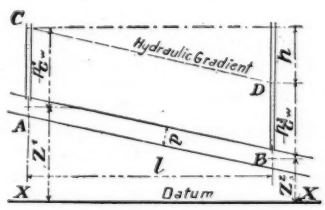


FIG. 1.

FLOW OF WATER IN PIPES.

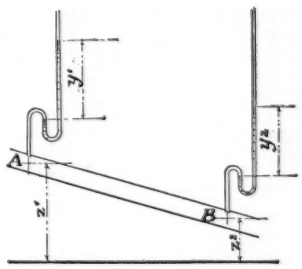


FIG. 3.

HEAD LOST IN SLOPING GAS-MAINS.

is identical with the equation above, except that h is measured in inches of water and h/s is proportional to the head lost, measured in feet of gas; also the units are different, and one particular value has been selected for the constant ζ. In calculations of this kind, it is best to adhere to a simple and uniform system of units; and in this paper the equations will all be expressed in "foot, second, pound" units.

Estimation of the Head Lost in Horizontal Gas-Mains.—The pressures in gas-mains are usually determined by water-syphons. Consider a horizontal pipe (fig. 2). The difference $y_1 - y_2$ of the columns at A and B is the head lost in friction in the length A B, measured in feet of water. Before using this in the hydraulic equations (2), it must be reduced to feet of gas. Let G_w, G_a, G_g be the weights, in pounds, of a cubic foot of water, air, and gas respectively. Let s be the density of gas (air = 1). Then

$$G_g = s\, G_a$$

Hence, the height of a column of gas equivalent to the water column $y_1 - y_2$ is

$$\frac{G_w}{sG_a}(y_1 - y_2) \text{ feet.}$$

For average cases, $G_w = 62{\cdot}4$ and $G_a = 0{\cdot}08$. Hence the head lost in friction, in feet of gas, is

$$h = \frac{G_w}{sG_a}(y_1 - y_2) = 780\,\frac{y_1 - y_2}{s} \quad . \quad . \quad . \quad (5);$$

and this value introduced in the hydraulic equations (2) makes them applicable to gas-mains. To be quite clear, h is the difference of pressure at A and B in feet of gas, and $y_1 - y_2$ the same quantity in feet of water.

Head Lost in a Gas-Main which is not Horizontal.—The determination of the head lost when the main is not horizontal (fig. 3) is a little more complicated. In a falling main the atmospheric pressure is greater at B than at A by the amount $G_a(z_1 - z_2)$ lbs. per square foot, or

$$\frac{G_a}{G_w}(z_1 - z_2) \text{ feet of water,}$$

a quantity which is negative if the main is a rising one. This must be deducted from the pressure difference $y_1 - y_2$ measured by the syphons. Hence, proceeding as before,

$$h = \frac{G_w(y_1 - y_2) - G_a(z_1 - z_2)}{sG_a} + z_1 - z_2$$

$$= \frac{G_w}{sG_a}(y_1 - y_2) + (z_1 - z_2)\left(1 - \frac{1}{s}\right) \quad . \quad . \quad . \quad (6)$$

or, taking the value above—

$$h = 780\,\frac{y_1 - y_2}{s} + (z_1 - z_2)\left(1 - \frac{1}{s}\right) \quad . \quad . \quad . \quad (6a)$$

When there is much difference of level of the points where the pressure is measured, the quantity $(z_1 - z_2)\left(1 - \frac{1}{s}\right)$ is too large to be neglected; in fact, there are cases of rising mains where the apparent difference of pressure shown by the syphons is negative, or where the station-meter pressure is less than atmospheric pressure. For instance, let the density of the gas be $s = 0{\cdot}5$, then $1 - \frac{1}{s} = -1$; also let $y_1 - y_2 =$ 6 inches, or 0·5 feet of water, so that $780\frac{y_1 - y_2}{s} = 780$. Then,

	$z_1 - z_2$	$(z_1 - z_2)(1 - \frac{1}{s})$.	h.
Falling main	100	− 100	680
,, ...	250	− 250	530
,, ...	500	− 500	280
Rising main	− 100	+ 100	880
,, ...	− 250	+ 250	1030
,, ...	− 500	+ 500	1280

Here the difference of level of the ends of the main makes great differences in the value of h.

Calculation of an Example.—In Mr. Paterson's paper "Notes on the Method of Calculating the Flow of Gas,"* there are given two observations of flow through a 16-inch main, 280 yards long, the outlet end of the main being 17·75 feet above the inlet. The specific gravity of the gas is given as 0·556; and the discharges with 1-inch and ½-inch pressure

* See "Transactions" of the Gas Institute, 1873, p. 110.

were 111,930 and 78,800 cubic feet per hour. Reducing to foot and second units—

$$d = 1{\cdot}333\,;\ l = 840\,;\ s = 0{\cdot}556\,;\ z_1 - z_2 = -17{\cdot}75\,;$$
$$y_1 - y_2 = \tfrac{1}{12} \text{ and } \tfrac{1}{24} \text{ foot.}$$

The co-efficient of friction, which is not exactly known, will be taken at 0·0049 the value given below for a 16-inch pipe.

$$h = 780\frac{y_1 - y_2}{s} + (z_1 - z_2)\,(1 - \tfrac{1}{s}).$$
$$= 780\,\frac{1}{12 \times {\cdot}556} + (-17{\cdot}75)\,(-0{\cdot}8).$$
$$= 131{\cdot}1 \text{ feet of gas.}$$
$$v = 4{\cdot}012\,\sqrt{\frac{d\,h}{\zeta\,l}} = 4{\cdot}012\,\sqrt{\frac{1{\cdot}333 \times 131{\cdot}1}{{\cdot}0049 \times 840}}.$$
$$= 26{\cdot}14 \text{ feet per second.}$$

$$\text{Discharge} = Q = \frac{\pi}{4}\,d^2 v = 36{\cdot}48 \text{ cubic feet per second.}$$
$$= 131{,}300 \quad \text{,,} \quad \text{per hour.}$$

Similarly for the test with ½-inch pressure, the discharge is 97,700 cubic feet per hour. These results are not in very close agreement with the observed discharges; but probably the pressures are not very exactly measured, and the barometric pressure is not given. If the co-efficient of friction was a little greater, the discrepancy would disappear.*

The Coefficient of Friction.—Before the equations of flow can be used in practical calculations, the value of the coefficient of friction ζ must be determined. There is no theoretical reason for assuming that the coefficient of friction for gas is different from that for water; and, indeed,

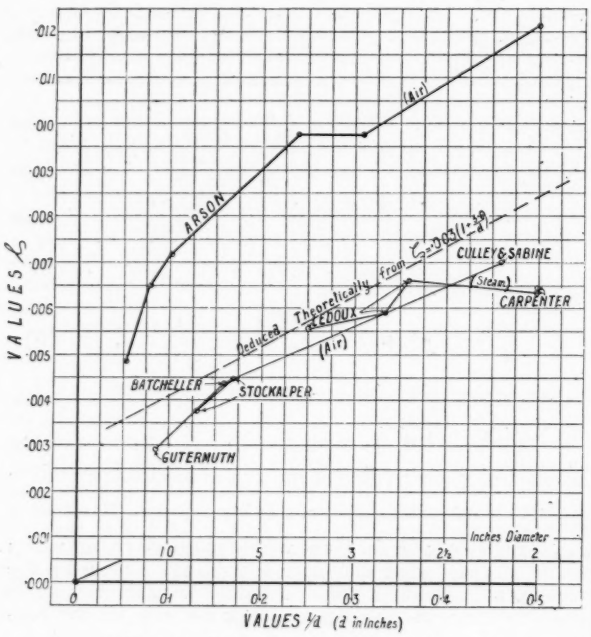


FIG. 4.—COEFFICIENT OF FRICTION.

Dr. Pole used a value which, in his time, was supposed to be an average value for water-mains. Still, it is uncertain whether the values are the same in the two cases; and it is extremely desirable to have some exact experiments on the flow of gas to determine the value of ζ. Unfortunately, so far as can be ascertained, there are very few experiments on the flow of gas in pipes; and these appear to have been made rather roughly, or at any rate without clear appreciation of the points to be observed. The condition of the pipes is nowhere noted, the barometric pressure is not noted, and no details are given of the method of taking the observations and the degree of accuracy obtained. When Dr. Pole published his formula, the variation of ζ with the size and roughness of the pipes was not understood; and he assumed a value about 0·006 for all cases. It is now certain that ζ is not constant, but varies a good deal in different circumstances, and that to assume it constant leads to not inconsiderable error.

* Dr. Pole's equation makes the discharge with 1-inch pressure 110,700 cubic feet per hour; but it neglects the difference of level, which, in this case, increases the discharge.

A few experiments on the flow of gas in pipes are given in Clegg, chiefly some made many years ago by Girard. Nothing is mentioned as to the levels of the ends of the pipes, though it is hardly possible all the pipes were exactly horizontal. The differences of pressure seem to have been roughly observed. Further, the results which give the same values of ζ for small and large pipes are very inconsistent with some experiments on the flow of air made under circumstances more likely to furnish accurate data. Hence it is not possible to be satisfied with these results.

The following table contains a reduction of these experiments; those on the shorter lengths of main being discarded as less trustworthy:—

Experiments on the Flow of Gas in Pipes. (*Clegg, p.* 301.)

Diagram of Pipe in Inches.	Area of Pipe in Square Feet. ω.	Length in Feet. l.	Pressure in Inches of Water. 12h.	Specific Gravity of Gas. s.	Velocity in Feet per Second. u.	Quantity in Cubic Feet per Hour.	Quantity in Cubic Feet per Second. Q	ζ
0·62	0·00212	414	1·34	0·559	6·94	53	0·0147	0·0063
18.0	1·767	5,280	1·00	0·400	10·4	66,c00	18·3	0·0068
0·5	0·00136	177	1·25	0·400	12.3	60	0·0167	0·0051
10 0	0·545	5,280	3·00	0·400	15·3	30,000	8·34	0·0053
26·0	3·69	9,390	0·80	0·420	7·75	103,c00	28·6	0·0075
26·0	3 69	12,900	2 25	0·420	13·2	175,000	48·6	0·0054
25·0	3·69	12,900	0·48	0·420	6·0	80,000	22·2	0·0054
							Mean	0 0060

It has been completely established that ζ varies with the roughness of the pipe; but there are no data available to determine this variation in the case of gas-pipes. The best that can be done is to assume a value suitable for pipes in fair condition, until fresh experiments are made. But as to another variation, something can be done. It is practically certain that ζ varies with the diameter of the pipe; it is greater for small pipes, and less for large pipes. In fig. 4 are plotted a number of values of ζ deduced from experiments on the flow of air and steam in long mains. It will be seen that in all these series there is a considerable decrease of ζ with increase of diameter, and that for large mains ζ is smaller than the value 0·006 deduced from the experiments on gas in the table above.

Some years ago, the author deduced, chiefly from tests on the Paris compressed air mains, the expression—

$$\zeta = 0{\cdot}0025\,(1 + \frac{3}{10d})$$

where d is in feet. Probably these mains were rather exceptionally smooth. The dotted line on the diagram is drawn for $\zeta = {\cdot}003\ (1 + \frac{3}{10d})$; and it will be seen that it follows the general slope of the observations fairly. The plotted results agree very well with each other except the very old experiments of Arson. As to these, there must have been some special cause of large resistance, or else the results are not accurate. Taking all things into account, and allowing some weight to the gas experiments, perhaps nothing better can be done at present than to take the following expression as giving the value of ζ for gas-mains:—

$$\zeta = 0{\cdot}0041) + \frac{1}{7d}) \quad . \quad . \quad . \quad (7)$$

until some new experiments are made. The following table gives the values of ζ for mains of different sizes:—

TABLE I.—*Values of ζ for Gas-Mains.*

Diameter of Pipe.	Value of ζ.
2 inches	0·c082
6 ,,	0·0057
12 ,,	0·0050
18 ,,	0·0048
24 ,,	0·0047

Size of Main for a Given Discharge with Different Pressures.—The question of the advantage of conveying gas under greater pressures than are at present usual may now be considered. It will be most convenient to take a definite case, and to calculate the head required to force gas through mains of different sizes. If the gas is compressed, its volume will be decreased and its density increased. But it complicates the equations seriously to introduce a correction for this; and as a first step this correction may be neglected,

and the error so introduced can be examined afterwards by using a more exact formula. It will be assumed that 50,000 cubic feet of the gas per hour, or 13·9 cubic feet per second, of density, $s = 0{\cdot}4$, are to be conveyed; and the value of ζ will be taken from eq. (7). Let d be the diameter of the pipe in feet, and ω the area of the section of the pipe in square feet. Then the velocity in the main is $v = 13{\cdot}9/\omega$ feet per second. If $y_1 - y_2$ is the difference of pressure in feet of water, then by eq. (2) and (5)

$$\frac{780\,(y_1 - y_2)}{s} = \zeta \frac{v^2}{2g} \frac{4l}{d}$$

Putting $l = 5280$ feet; $s = 0{\cdot}4$; this reduces to

$$y_1 - y_2 = 0{\cdot}1683 \frac{\zeta v^2}{d}$$

TABLE II.—*Head lost in Friction in Feet (of Water) per Mile. Main discharging 50,000 Cubic Feet per Hour, or 13·9 Cubic Feet per Second of Gas, of Density 0·4.*

Diameter of main, inches	4	6	8	12	16
,, ,, feet	0·333	0·5	0·666	1·0	1·333
Value of ζ	0·0063	0·0056	0·0053	0·0050	0·0049
Velocity in feet per second	160	71	40	18	10
Head lost, per mile—					
Measured in ft. of water	82·1	9·6	2·2	0·27	0·062
,, in lbs. per sq. in.	35·3	4·1	1·0	—	—

With the smallest pipe delivering into atmospheric pressure at the delivery end, the absolute pressure at one end would be about 50 lbs. per square inch, at the other 15 lbs.; the mean pressure would be about 33 lbs. per square inch, and the density more than double the value assumed in the calculation. On the other hand, the volume would be correspondingly reduced, and the velocity of flow less. The calculation is, therefore, necessarily inexact; and the error will be determined presently. The error would be greater but that wrong assumptions partly balance each other. Except this case, the assumptions are not very much in error for the other sizes of pipe; and the calculated results are very nearly right. The 12-inch and 16-inch mains correspond to cases which might well occur in ordinary practice. The pressure producing flow is 3·2 inches per mile in the former case, and ¾-inch per mile in the latter. But the 6-inch main would convey the same quantity of gas, at a quite reasonable velocity, with a pressure of 4·1 lbs. per square inch—a very moderate amount of compression. The 4-inch main is perhaps for most situations undesirably small; but there is nothing impossible even in using a main as small as this.

Mr. H. E. Jones has been good enough to supply the prices per mile of mains of the sizes stated above, laid in place in London.

Cost of Mains per Mile.

Diameter, inches	4	6	8	12	16
Cost per mile	£370	605	763	1276	1936

It will be seen that by using higher pressures, the economy of cost of mains is very great.

More Exact Formula for the Flow of Gas in Pipes; the Change of Volume and Density being taken into the Reckoning.—Some years since, the author investigated the law of flow in compressed-air mains, and checked the results by very careful tests made in the Paris air-mains. The formula obtained* looks complicated; but it is easy to use to check the calculation of discharge by any given main under a given difference of pressure. The general equation is—

$$u_1 = \sqrt{\left\{\frac{g\,c\,\mathrm{T}d}{4\,\zeta\,l} \quad \frac{p_1^2 - p_2^2}{p_1^2}\right\}} \quad . \quad . \quad . \quad (8)$$

where u_1 is the velocity in feet per second at the inlet of the pipe, d the diameter, and l the length of the pipe, p_1 p_2 the pressures at inlet and outlet, T the absolute temperature of the fluid, and c the the constant in the fundamental equation for elastic fluids $\mathrm{PV} = c\mathrm{T}$. For air, $c = 53{\cdot}18$, and for any other gas of density s (air = 1·0) $c = 53{\cdot}18/s$.

* See "Transmission of Power from Central Stations." By W. C. Unwin, p. 212.

Hence for a gas at the temperature of 50° Fahr. or 511° absolute, the equation becomes—

$$u_1 = 468 \sqrt{\left\{\frac{d}{\zeta\,s\,l} \quad \frac{p_1^2 - p_2^2}{p_1^2}\right\}} \quad . \quad . \quad . \quad (9)$$

The expression is based on the assumption that the temperature of the gas flowing through the main is practically constant. The pressures p_1, p_2, may be taken in any units; but they are absolute pressures. In the notation above, y_1 and y_2 are the syphon pressures, in feet of water; and hence (1 atm. = 34 feet) the absolute pressures at the inlet and outlet when the main is horizontal are $p_1 = y_1 + 34$ and $p_2 = y_2 + 34$. For a sloping main, the pressures are easily obtained from the expressions above. Let u_1 and u_2 be the velocities at the inlet and outlet in feet per second. These velocities will be inversely as the pressures, so that

$$u_2 = \frac{p_1}{p_2} u_1$$

and if Q is the discharge in cubic feet per second, measured at the pressure p_2,

$$\mathrm{Q} = \frac{\pi}{4} d^2 u_2 = \frac{\pi}{4} \frac{p_1}{p_2} d^2 u_1 \quad . \quad . \quad . \quad (10)$$

It may be noted that if $p_1 - p_2$ is small,

$$\frac{p_1^2 - p_2^2}{p_1^2} = \frac{p_1 - p_2}{2\,p_1} \text{ nearly;}$$

and if this is substituted in eq. (9), it reduces to the hydraulic equation.

It is possible now to check the calculations in the table above made by the approximate hydraulic formula. The differences of pressure there found will be assumed, and the velocity and discharge recalculated by the exact formula. The difference will show the error of using the hydraulic formula.

TABLE III.—*Recalculation of Discharge of Mains of Various Diameters (One Mile Long) by Exact Formula. (Density of Gas 0·4; Atmospheric Pressure taken at 34 Feet of Water. Differences of Pressure per Mile as in Previous Table.)*

Diameter of main d, inches	4	6	8	12	16
,, ,, feet	0·333	0·5	0·666	1·00	1·333
Area of main w, square feet	0·087	0·196	0·348	07·85	1·389
Pressure at inlet, p_1, in feet of water	116·1	43·6	36·2	34·3	34·06
,, at outlet, p_2	34·0	34·0	34·0	34·0	34·0
$\frac{p_1^2 - p_2^2}{p_1^2}$	0·9143	0·3919	0·1176	0·0153	0·00345
$\frac{p_1}{p_2}$	3·42	1·28	1·07	1·01	1·00
Velocity at inlet, u_1, ft. per sec.	70·84	60·26	39·16	17·83	9·87
,, at outlet, u_2, ,,	242	77	42	18	9·9
Discharge, cubic feet per sec.	21·0	15·1	14·6	14·1	13·8
,, ,, hour	75,600	54,360	52,560	50,760	49,680

Comparing the results in Tables II. and III., it will be seen that for the larger pipes with small pressure differences the discharge calculated by the hydraulic formula (2) does not differ much from that calculated by exact formula (9) and (10). On the other hand, for large pressure difference in the case of the 4-inch main, the exact formula gives a discharge 50 per cent. greater than the hydraulic formula. The curves in fig. 5 show how the divergence of the exact and hydraulic formulæ increases rapidly for large pressure differences. In the case of gas-mains worked at high pressures, the exact formula must be used.

The Possibility of Distributing Gas at Greater Pressures than are now usual.—It has been shown that the discharge of a main depends on the pressure difference per mile of main, and that with considerable but perfectly manageable pressure differences much smaller mains could be used than are usually adopted. All that is necessary is to have compressing machinery at the station and pressure regulating apparatus at the points of delivery. It is clear that in this way the economy of cost of mains would be very great. The question of the desirability of this is a live one, because it has been demonstrated in the United States that lighting gas can be distributed at considerable pressures, without any serious difficulty and with great economy in the cost of distribution. It will be known to most gas engineers that Mr. F. H. Shelton, of Philadelphia, read a very interesting paper at the International Gas Congress at Paris, in 1900, describing successful examples of gas distribution at high

pressure—some of them carried out under his own direction. Wrought-iron screwed mains were used; and these were found to be practically tight against leakage. Ordinary compressing and pressure regulating apparatus worked satisfactorily. Lastly, no serious deterioration of the gas

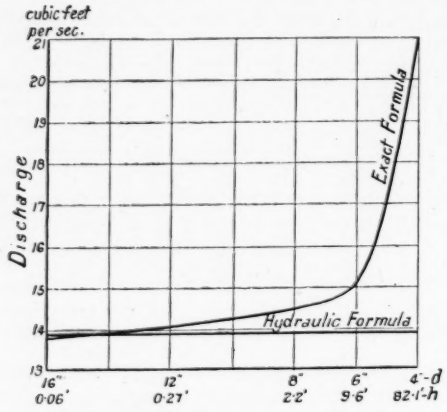


FIG. 5.—DISCHARGE OF GAS-MAINS ONE MILE LONG.

occurred as a consequence of compression. The following table gives particulars of some cases selected from Mr. Shelton's paper:—

TABLE IV.—*Gas Distribution at High Pressure in the United States.*

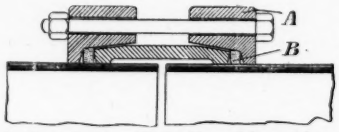
Locality.	Description Gas.	Distance of Transmission in Miles.	Diameter of Main. Inches.	Initial Pressure. Lbs. per Sq. In.	Terminal Pressure. Inches of Water.	Quantity Cubic Feet per Hour.
Louisville	Coal gas	2¾	10	5 to 7	10	140,000
Oakland	Coal and water gas	8	8	5	4	—
Chicago	Water gas	4	8	10	7	60,000
Danbury	Oil water gas	3	2	40	?	—
Phœnixville	Coal gas	5	3	10 to 25	?	5,000

In an address by Mr. G. Helps, of Nuneaton, it is stated that at Nuneaton there are six miles of mains conveying gas at anything up to 25 lbs. per square inch pressure, from which customers are supplied either at 20 inches or at 3 inches pressure. Mr. Charles Carpenter, of the South Metropolitan Gas Company, has also distributed gas at high pressure—using Westinghouse gas-engines and Sturtevant fans for compression.

Gas Distribution at Louisville.—In an American journal, ("Compressed Air," April, 1904), an account is given of an installation which is stated to be under construction by the Laclede Gas Company, of St. Louis, which is interesting as a development of the high-pressure system. It is intended, according to the article referred to, that the system shall ultimately extend over an area of 65 square miles. The pressures to be employed are approximately 5 lbs. per square inch for the medium-pressure feeders, and from 20 to 80 lbs. per square inch for the high-pressure suburban feeders. On account of the use of cast-iron mains, the 5 lb. limit was adopted for the medium-pressure system; but for the high-pressure system, wrought-iron or steel pipes will be used, with screwed joints.

In high-pressure gas-mains, the question of leakage, and of the joints which are least likely to leak, will be of governing importance. It appears that with the low pressures now in use, the amount of gas unaccounted for averages 7 per cent. of the make. There is not agreement as to how much of this is due to leakage; and conclusive tests do not appear to have been made on the leakage of mains. In the case of water-mains, it has been shown, by the use of district recording meters, that the leakage of mains is in many cases very considerable. In gas and water mains, lead joints are largely used; and lead is a plastic substance which, if deformed by expansion and contraction or settlement of the ground, does not recover its form. Hence lead joints, however well made, cannot be assumed to be permanently tight. In the case of the Birmingham compressed air mains, which were laid with lead joints, it has been stated that before they were abandoned the leakage amounted to 40 per cent. of all the air pumped in. In this case, there was considerable variation of temperature in the mains, and much expansion and contraction.

In the system of compressed-air distribution in Paris, a joint made with india-rubber rings was used; and with this it was found, on very careful tests, that the leakage was insignificant. The joint is shown in fig. 6.



A. Cast Iron. B. India-rubber Ring.

FIG. 6.—PARIS JOINT (COMPRESSED AIR).

It possibly would be unsuitable for gas, although the india-rubber is well protected from access of air or oil. But it represents almost an ideal joint; because, however often deformed, the elastic packing recovers its original form. The expansion and contraction of the main is perfectly free; and the joint is tight under extremely high pressures.

It may be pointed out that, though other things being the same, the leakage would vary as the square root of the excess of pressure in the main above atmospheric pressure, being doubled if the pressure is increased fourfold, yet it must also be proportional to the circumference of the pipe; so that with small mains the leakage is less than with large ones. If the difference of pressure at the two ends of a main is p, the mean excess of pressure in the main is about $\frac{1}{2}p$, and the leakage in a main of diameter d will be proportional to—

$$d\sqrt{\left(\tfrac{1}{2}p\right)}$$

Thus, taking the mains one mile in length, with the pressures and diameters given in Table II., we get the following figures for the proportionate leakage, if all the other conditions as to joints, &c., are the same:—

TABLE V.—*Leakage of Mains.*

Diameter, inches	4	6	8	12	16
$\frac{1}{2}p$., feet of water	41	4·8	1·1	0·13	0·03
Proportionate leakage $d\sqrt{(\frac{1}{2}p.)}$	25·6	13·1	8·3	4·4	2·8
Ratio of pressures	1366	160	37	4·3	1·0
Ratio of leakage	9·1	4·7	3·0	1·6	1·0

Comparing the 6-inch and 16-inch mains, while the excess of pressure in the 6-inch is 160 times that in the 16-inch, the leakage is only 4·7 times greater. Nevertheless, the question of leakage is the most serious one to be considered in adopting high-pressure gas distribution.

Mains and Leakage.—Hitherto gas-mains have usually been of cast iron; but the adoption of higher pressures and smaller mains would probably lead to the use of some of the forms of steel pipe which are now largely employed in systems of water supply. The author is informed that for the Mond system of distributing producer gas for power purposes, the smaller mains will be ordinary steel pipes with screwed joints; and the larger pipes will be of the type first used on a large scale for the water-main from Perth to Coolgardie. This is a main 270 miles in length. The section of the main is shown in fig. 7. Two steel sheets are bent to semicircular form, and the edges a little spread. A slotted bar is slid over each pair of plate ends, and closed on them by pressure. Manufactured by machinery, this is a very cheap and strong main. The longitudinal joint is quite as strong as the solid plate; and the pipes can be made in 30 foot lengths, which reduces the number of transverse joints. Steel being four times the strength of cast iron, the pipes may be very thin. The cross joints for the Mond System are to be lead joints, as shown in fig. 8, somewhat on the plan of the well-known Kimberley joint.

Distribution of Gas for Power Purposes.—One of the most interesting cases in which gas is likely to be distributed at high pressure is the case of producer gas distributed from a central station over a district for power purposes. The author

has before called attention to the large amount of power, or at least means of obtaining power, which can be conveyed in comparatively small mains in the shape of gas for use in gas-engines. It will be useful to examine a particular case. Suppose the main to be 5 inches in diameter and a mile long. The density of producer gas varies, but may be taken at 0·55.

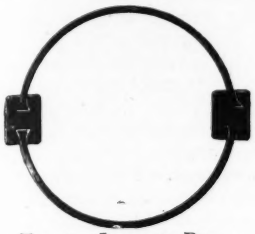
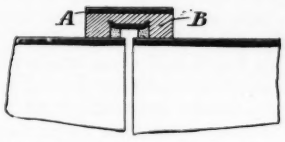


FIG. 7.—LOCKING-BAR. LONGITUDINAL JOINT.



A. Steel Ring. B. Lead.

FIG. 8.—TRANSVERSE JOINT.

COOLGARDIE WATER-MAINS.

Then, using formula (9), we get the following results, if in calculating the horse power, it has been assumed that of ordinary quality, 60 cubic feet per hour will give 1-horse power:—

TABLE VI.—*Quantity of Producer Gas Conveyed in a 6-Inch Pipe, 1 Mile Long, under Various Differences of Pressure. Density of Gas taken at 0·55.*

Pressure at inlet, pounds per square inch, p_1, .	19·7	24·7	29·7	34·7
,, ,, outlet, ,, ,, ,, ,, p_2, .	14·7	14·7	14·7	14·7
Pressure difference, pounds per sq. in. . . .	5·0	10 0	15·0	20·0
Velocity at inlet, feet per second, u_1, . . .	54	65	71	74
,, outlet, ,, ,, u_2 . . .	70	110	143	174
Discharge in cubic feet per second at atmospheric pressure and temperature . . .	13·8	21·5	28·0	34·1
Horse power transmitted	828	1290	1680	2046

Hence, even in a 6-inch main a very large power can be conveyed at pressures quite practicable.

Discussion.

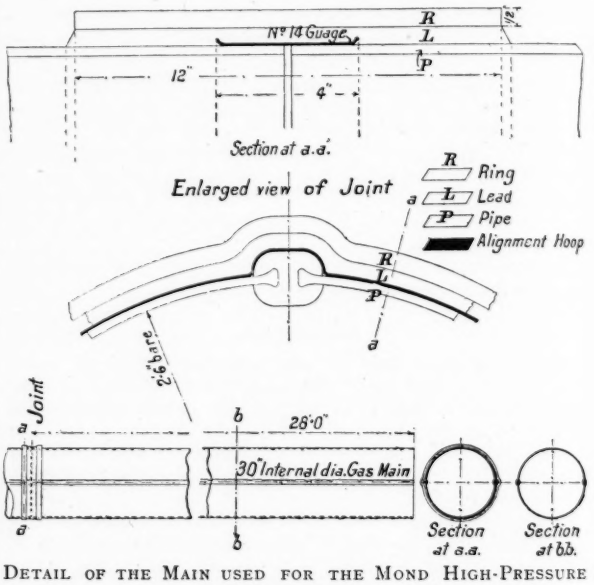
The PRESIDENT said he was sure they would all agree that he had judged rightly in asking Professor Unwin for this paper, and that what he had put before them would help them on the path they were all seeking for (especially those who were seeking to distribute power)—that of economical distribution. He had dealt with the subject in a masterly fashion, and had added to their annals matters on which they could base their work for the future with a great deal more satisfaction than they had been able to in the past. It did not take much reading on his part some thirty years ago to find how extremely difficult of acceptance were the lines laid down, especially when it was perfectly obvious that they were absolutely on the lines of the conveying of water. In the one case, they had a perfectly inelastic fluid; and in the other, a very elastic fluid indeed, and of such great difference of density that one saw there must be very wide differences. They were especially at sea with the old formula, in not knowing how to provide for the frictional resistance of bends and right-angles, which were constantly occurring. They could not, owing to the crowded state of the subsoil, get a straight line or a level, but had to be constantly digging and diving, and twisting and turning; and they were thankful to Providence if they got through at all in some cases, instead of observing that uniformity of gradients and directness of route which all formulæ depended upon. It was laid down in a paper he read two years ago before the Institution of Civil Engineers, that they were very much governed by the capital cost in the first place; and in putting a main in new roads, they had to be careful, on the one hand, that it should not be too large to be economical, and, on the other hand, not too small to admit of the proper attachments for the reasonably probable amounts of demand on the main within a limited period, after which they might add a second main of more or less diameter as the case might require. He was quite sure they would all join in a hearty vote of thanks to Professor Unwin. He saw, a few days previously, gas being delivered at Nuneaton at 25 lbs. pressure; and he had received a communication from Mr. G. C. Trewby, of the Gaslight and Coke Company, who could not be present, which pointed to a piece of very valuable information with regard to their working. As Mr. Trewby was well represented by Mr. Goulden, he would ask him to give them some of the results of the actual experience of work done in this direction.

Mr. T. GOULDEN (London) said he desired to add his personal thanks to Professor Unwin for the very valuable paper contributed by him, as being one which had brought them right up to date, and had added a most valuable text-book to their technical information. He was glad the President remembered that Mr. Trewby originated the high-pressure system of distributing gas through the trunk mains of the Gaslight and Coke Company, which apparently was not known to Professor Unwin, who said he regretted that there was not installed any compound system of bringing gas through a main at a high pressure and delivering it to the consumers at a low pressure. Soon after getting to work at Beckton (now over thirty years ago), they found that the two 48-inch mains which brought gas to London were not enough to deliver the volume required at the holder pressure they had; and to overcome the difficulty, they instituted comparatively high-pressure pumping—this being the first installation of the system, so far as he was aware, in the country.* They had now reached an initial pressure of 48 inches of water, or about 2 lbs. on the square inch, which was somewhat high for large mains jointed with lead. They pumped by means of the high-pressure system practically over the whole of London, from Beckton in the east as far as Fulham in the west; and they could transfer the gas from this high-pressure main either into holders from which they could deliver to a distributing low-pressure system or into other places. They passed the gas direct from the high-pressure system by means of governors into the low-pressure system. As a matter of fact, a large proportion of the gas distributed was never stored in a holder at all. There could be no doubt that, whether they liked it or not, a system of high-pressure must come—at any rate, in places like London and other large cities—because it was evident that the very great increase of mains, which served so many purposes, and had to go underground where all the space was practically taken up, would make this a necessity. Apart from this, the need and advisability of keeping down the capital account brought them to the same result almost as quickly. At the same time, this was a matter upon which it was just as well to "hurry slowly," because they had to make the best use of the material at their disposal which was already laid down; and it would be out of the question to take up all the present cast-iron mains jointed with lead, and replace them with steel mains of sufficient strength to carry the high pressures which had been mentioned. They ran through valuable property with their gas-mains; and, unlike water, which was innocuous, although a nuisance, if there was a big leak), gas, especially when it travelled from a leak under a modern road, which was practically impervious to it, passed as a consequence into the basements of houses, where it was a source of danger that might wreck very valuable property. Though in the light of the high pressure suggested, Dr. Pole's formula would not apply—because they saw that when they got away from the pressures they had been used to, Professor Unwin's Twentieth Century formula ran very much away from the old formula of Dr. Pole—still, so far as they had gone, or were likely to go for some little time, they must not forget that they were very much indebted to Dr. Pole. A set of experiments was made some time ago, both on 48-inch and 36-inch mains, as well as on those of a smaller size; and having regard to the differences in pressure and in the elevation of the starting points as compared with the final points, they found that Dr. Pole's formula did not give much more than an average difference of 3 per cent. This was for pressures not exceeding 48 inches of water. At any rate, it had been of very great value; and by means of this formula, they had been able to locate certain subsidences in the mains which happened between the syphons. They had the mains pumped out thoroughly; and when they were quite clear, it brought the volume delivered up again to a quantity comparable with that expected to be passed. He took it that all the formulæ given in the paper were for straight pipes; but if Professor Unwin could give any information with regard to the friction thrown by bends, it would be of great value

* Some further particulars of the installation here referred to are given in a supplement to the discussion sent by Mr. G. C. Trewby—see p. 861.

—this being a point affecting the delivery of gas-mains on which they had very little information.

Mr. H. A. HUMPHREY (London) said that, as an old student of Professor Unwin, he became acquainted with the formula many years ago, and had made extensive use of it. He was quite sure the present paper would become an absolute necessity to every gas engineer, because, if they had not already reached, they were rapidly approaching, the time when lighting gas would be distributed under higher pressures; and then the difference between this formula and the old one, which had done good service for many years, would become so pronounced that they could not but use the new information now brought forward. He assumed that he had been asked to speak because he had, as Consulting Engineer to two Statutory Companies authorized to distribute producer gas under pressure, something to do with the Mond gas system, and had had to investigate very carefully all the factors concerned in the distribution of gas over large areas, and the kind of mains which had to be employed. Perhaps if he gave briefly some of the results he had obtained, they might be helpful. In the first place, they had to deal with producer gas in very large quantities. They were starting in South Staffordshire with the comparatively small quantity of 1 million cubic feet an hour; but that was only part of the first station, which was laid out for four units of that size. They had therefore to deal with large pipes; and as they had to use pressure, they were obliged to adopt a system of mains which was very safe. Safety was the first consideration, to which everything else had to be subordinated. The result of their investigations as to mains and joints, led to the use of one of the types of pipe illustrated, and which Professor Unwin had described. He now showed a specimen section cut from a Ferguson patent locking-bar pipe 26 inches in diameter. This was the smallest size of that particular kind of mild steel pipe which had been manufactured in large quantities for the South Staffordshire Mond Gas Company. The larger mains ranged up to 36 inches diameter. These mains were tested up to 300 lbs. per square inch. Every main, before it was laid, was subjected to this pressure. They had not had any trouble with the lock-bar arrangement. The pipes stood remarkably well; and one need not have the slightest hesitation in asserting that the locking-bars, pressed over by hydraulic power, were absolutely tight. Therefore, as far as the pressure test of the mains went, it was entirely satisfactory; but then they had to deal with the joints. He investigated every type of joint known at the time, or which he could discover. The joint Professor Unwin drew attention to, as adopted by the authorities for the Paris compressed-air scheme, was very attractive; but experiments showed that india-rubber would not stand the attack of gas, and therefore its use in permanent systems was absolutely out of the question. The gas and products of condensation would yet pass the sleeve at certain points and attack the rubber; and though the attack might be confined to one corner, experiments showed that india-rubber could not be trusted. He designed a flexible joint specially arranged to prevent the gas or products of condensation coming in contact with the jointing material; but this was found too expensive for ordinary use. Then he tried some experiments with lead joints; and, in spite of all that had been said about them, when properly made he believed lead joints would stand indefinitely. The one shown in fig. 8 was intended to represent the kind of lead joint finally adopted; but it was not quite accurate, though it gave the essential features. He had a drawing with him which he would leave for inspection. [He also made a sketch upon the blackboard, and explained the construction of the joints.] A band of strong hoop-iron was put round the joint, slightly turned up at the edges, and made to fit the pipe as closely as possible. Over this was a steel sleeve; and the intervening space was run in with lead. This joint was quickly and easily made in the trenches; and as far as experience went, it was going to stand perfectly well. It was very cheap and simple, and had gone a long way towards making the use of this class of main for pressure gas absolutely successful. As they laid the main, they tested it in lengths of about 200 yards, and then put all the mains under a pressure of 30 lbs. per square inch. The joint was somewhat like a Kimberley joint, without the constricted centre portion of the sleeve, and with the lead run solid throughout instead of in two portions. They had introduced the iron alignment or inner ring, which held the two ends of the main in line when making the joint in the trench; and this replaced the central portion of the Kimberley collar. Another advantage of the Ferguson pipes was that they got them in 28 feet lengths; and consequently there were only one-third the number of joints to deal with. The district of South Staffordshire, in which they were laying the mains, being a mining area, there was a good deal of subsidence; and they had to adopt a pipe which would stand some amount of displacement. These pipes would, he believed, put up with some punishment of this kind; and there was no fear of their cracking owing to stress from subsidence of the ground. With cast-iron pipes, they would be faced with very serious difficulties if one cracked. Another important consideration affecting the choice of pipes was the question of cost. The Ferguson locking-bar mains were considerably cheaper than cast iron. For example, a 36-inch main of cast iron of the same diameter would cost nearly 50 per cent. more per lineal yard. Finally, the subject of the life of the pipe had to be investigated. They had a good pipe which was tested under all sorts of conditions; but when they had laid it, they were faced with the question, Was it going to last? If it was not protected, it would not last; and the question was how to protect it from attack by any acid water draining from refuse-tips, cinder-heaps, &c., and which might percolate through the ground, and, coming in contact with the pipes, cause them to decay rapidly. If they were laid in good



DETAIL OF THE MAIN USED FOR THE MOND HIGH-PRESSURE GAS SUPPLY.

clay, there might be no great difficulty; but if they were placed in bad ground, the question of attack was of serious importance. They had tried all kinds of coating, and came at last to something which was cheap and simple. The pipes were taken hot, and covered with a bituminous coating which did not differ much from certain compositions in general use, but was put on rather thicker. While still hot, they took a roll of cloth (say 18 inches wide, and very open in texture—in fact, a kind of string cloth), and this was attached to the sticky pipe at one end, and wound spirally round it all along; while the pipe was rotated in headstocks. Then, while the pipe was still hot, it received another layer of the same coating composition, which went through the pores of the cloth, and fastened the two layers together. They thus secured an absolutely secure protection from rust and access of water; and it was made mechanically strong by means of the cloth. The pipes had been knocked about in all sorts of ways—rolled over the yard, and so on—and this particular kind of covering seemed to meet all the requirements. The cost was about 9d. per square yard covered. With this pipe thus protected, they had no fear. He could trace the history of a steel pipe that had been laid even without this kind of extra protection, which had lasted since 1877; and those who were best acquainted with the subject, said they did not yet know the life of a steel pipe, as none properly laid had worn out in service. But with this particular type of

covering, taking great care in the application of the coating, and wrapping the joints in the same way as the body covering after they were made, they believed the pipes would last practically as long as cast iron. They had a large number of considerations to take into account in deciding on the working gas pressure to be adopted in South Staffordshire. On the one hand, there was the question of capital outlay; and, on the other hand, the working expenses, because it cost money to compress gas. The result of careful investigation was that 7 lbs. to the square inch was the proper pressure at which they could distribute most economically during the early years of the scheme; and this had been finally adopted. But the mains were quite strong enough, and the joints were sufficiently good, to allow them to increase the pressure as might be required from time to time to meet a larger output.

Mr. JOHN WEST (Manchester) said he was satisfied from the information he had obtained while in America that gas engineers would have to consider the desirability of supplying gas through small pipes under pressure. This system was largely adopted there. He had had the opportunity of meeting Mr. Shelton and others; and they gave him several instances where they could not possibly afford to put down ordinary mains, because of the large areas that they had to supply, unless they employed the high-pressure system. By so doing, however, they could supply these districts economically. He was very much surprised at the number of places where the system had been adopted; and there did not appear to be the difficulties he had anticipated. The system had been in vogue for some little time; and the difficulties had been overcome. As a proof that it could be done on a large scale, he gathered some information about the natural gas which was being delivered from Virginia to Cleveland, a distance of some 200 odd miles, or about the distance from London to Manchester. This natural gas was sent under about 200 lbs. pressure, and was then reduced, stage by stage, and distributed in Cleveland at 5 lbs. pressure, or 2 lbs. less than was proposed to be used with producer gas. This natural gas had a calorific power of about 1000 British thermal units. If gas could be supplied at high pressures, they might have competitors supplying gas from south to north or from north to south, if they could find a means of passing the gas the requisite distance under these improved systems. He himself thought that the high-pressure system would come into vogue, as there was no apparent difficulty about the pipes. The pipes he referred to were, he believed, 16 inches in diameter; and after going the 200 miles with this pipe, they had already laid 70 miles of screwed steel mains in Cleveland for distributing the gas, and were about laying—and had probably by now laid—70 miles more. This natural gas was being supplied for both cooking and power purposes only, upon a large scale and at a very cheap rate per 1000 cubic feet; so that it was a strong competitor with the ordinary coal gas.

Mr. CHARLES HAWKSLEY (London), being called upon, said he had not had that opportunity of looking up the subject which was really necessary in order to discuss properly Professor Unwin's formula of the flow of gas in pipes; but they could not do otherwise than accept the valuable formula which he had laid before them. He was glad to see that Professor Unwin had paid a tribute to the assistance which the well-known formula of Dr. Pole had been to gas engineers in the past, when dealing with the pressures which had hitherto obtained, and had pointed out that at these pressures there was no very great variation between Dr. Pole's formula and the new one, although when higher pressures were reached, there was a very great difference. He should like to make one observation with regard to steel pipes. They had heard of their great capability to bear internal stress, which was, of course, uniformly distributed; but he thought the chief thing which would have to be looked to in these pipes was their capability to bear those unequal external stresses to which they would be subject in various places, especially when laid in roadways subject to heavy traffic. He should like to ask Mr. Humphrey whether the coating of which he spoke was put first on the pipes, and then afterwards on the cloth in which they were enveloped, by dipping the pipes into tanks in the way in which it was customary to coat cast-iron pipes; and also how the coating was applied to the cloth surrounding the joints after the pipes had been laid in the trench.

Mr. HUMPHREY said that unfortunately they could not dip the pipes in the same way as an ordinary cast-iron pipe, not because of anything in the mechanical process, but because the coating inside the pipe (under the action of gas) was liable to peel off. Therefore they were obliged to block up the ends of the pipes, and then float them in the tank of liquid composition and revolve them, so that they got coated all over. The inside was only just covered with the slightest possible brushing of tar. When the pipe was taken out of the tank, it was placed between revolving headstocks, and the cloth was simply wound on. The second layer of composition was put on by something which very much resembled a mop. There were two or three men ranged along the pipe who did this work, dipping the composition out of the tank, and putting it on as hot as possible. It gradually cooled as the pipe revolved, and they could build up the coating to any thickness they liked. They made it about $\frac{1}{4}$ inch. The joint had, of necessity, to be coated in the trench itself; and this was done by a mop, with nearly boiling material. This process was a little more trouble, and took more time, because they had to wait until what was already on the pipe cooled sufficiently to put on an extra layer, and so build it up to $\frac{1}{4}$ inch thick. The cloth was put in between, just the same as when the pipe itself was coated. In reply to a further question, he said the sleeve was shaped so as to pass over the longitudinal bar. There was the same thickness of lead all the way round the joint. The end of the pipe was, of course, kept clean until the joint was made; otherwise the hot lead would burn the composition.

The PRESIDENT said they were much obliged to Mr. Humphrey for adding so much to their information.

Mr. HAWKSLEY said he would only mention that with water-pipes (which, however, were not now under discussion) the life of steel pipes depended somewhat on the action of water on the steel, which might be more or less rapid according to the chemical quality of the water; and, similarly the action on steel pipes of the products of condensation of gas would have to be taken into consideration. He gathered from Mr. Humphrey that this had not so far been found to be a difficulty. He understood that, with a view to ascertain the effect of the external stresses to which he had referred, some experiments had been made by Messrs. Thomas Piggott and Co., of Birmingham, in regard to the external pressures which steel pipes would sustain without altering their form.

Mr. ALEX. WILSON (Glasgow) said they were very much indebted to Professor Unwin for his excellent paper, and also for the extra information elicited from Mr. Humphrey. He did not propose to discuss the paper; but he might say, for the information of members, that at the Provan works at Glasgow (where they were getting ready to start very soon), he took the opportunity of testing the pipes in the works to see what pressure they might expect under the different conditions of working. He got one of his assistants to run the exhausters with air through the mains into a large holder at varying degrees of velocity, trying to arrange as near as possible that the quantity delivered should approximate to 2, 4, 6, up to 12 million cubic feet per day. After he had all this information, he obtained a copy of Professor Unwin's paper. He might say, in regard to the experiments, that they were rather carefully made; and he had a note of the temperature and barometric pressure, and also the pressures taken at various points in the works. They discovered that Professor Unwin's formula worked out very closely to what they found for straight lengths of main; but, as Mr. Goulden had mentioned, there was a difficulty about the bends and tees. Their experience was that at the lower pressures, when they were sending small quantities of gas through bends and tees, it did not bother them very much; but as they reached still higher quantities—about 12 million cubic feet—they found they only got from about 70 to 72 per cent. of the calculated quantity of air through that they ought to have if it were a straight length of main. This information might be useful; and he had taken advantage of it himself in arranging for the pumping from the new Provan works down to the old Dalmarnock works, and allowed a considerable excess of power over that required for a straight length of main, owing to the deviations one had to make in passing through the streets. They had 24-inch, 36-inch, and 42-inch, mains; and the quantities of gas that they pumped through varied from 2 to 12 million cubic feet per day.

Mr. GEORGE HELPS (Nuneaton) said he felt some diffidence in discussing so scientific a paper as this; but he

would make a few remarks which, however crude, might appeal to some members as having a practical bearing. This was a matter in which he was particularly interested; and personally he should like to tender his sincere thanks to Professor Unwin for having brought under the notice of the industry the advantages of high-pressure gas. He had been good enough to mention his name; and, of course, he also mentioned Mr. Shelton, to whom, in his opinion, the introduction of high pressures was mainly due, and to whom they all owed a very deep debt of gratitude. Few of them had begun to realize the advantages of high pressure; but, like everything else, its benefits would be understood in time. They need not fear any complexity in dealing with pounds of pressure instead of inches. There was nothing complex in it. It was the simplest thing in the world; and they would hardly believe, when they had had a few months' experience of a main with 25 lbs. pressure to the square inch, that they had ever worked with 2 inches of pressure. The question of leakage had been referred to; and the author had rightly said that many works had a leakage account of 2 per cent., while others had some 15 or 16 per cent., and that it was not leakage in the mains that would account for such a difference. With an average pressure of about 9 lbs. for eight months, the leakage for the year at Nuneaton had been less per mile of main than in any previous year; and the actual sale of gas per ton of coal had been more. So that he did not think there need be any fear as to the leakage going up in anything like proportion to the pressure; and such pressures as those now advocated were quite practical and rational. Under the heading "The Flow of Gas in Pipes," Professor Unwin, referring to some equations, said: "The above apply exactly to the flow of gas in pipes so long as the variations of pressure are not great enough to cause important changes of volume." As he had said before, these equations would take him a considerable time to grasp; but it occurred to him to ask the Professor if the quantity of gas passing through a pipe was not to be directly proportioned to the pressure applied. For instance, a pressure of 15 lbs. increased to 30 lbs. would double the volume passing. Was not this the proportion right the way through from inches to pounds? Professor Unwin also called attention to the fact that very few experiments had been made to determine the actual quantities of gas passing through various sized pipes of different lengths; and therefore it might, perhaps, be useful to state the result of his experience. When they put down the 3½ miles of 3-inch main now at work, he thought it would be a good opportunity to test the pipes under various pressures for their actual capacity. The meter used was one of Marsh's rotary meters, which was well tested under ordinary conditions. It might not be absolutely correct; but the results of the tests were roughly these: Three miles of 3-inch main, with 5 lbs. pressure, passed 5000 cubic feet per hour; with 10 lbs. pressure, 10,000 cubic feet; and with 18 lbs. pressure, 18,000 cubic feet. For some reason or another, they happened to drop on these figures; and he did not pursue his tests further, as he thought they would serve his purpose for the time being. With regard to jointing, the first three miles of main were steel Mannesmann tubes, with the ordinary open joints filled with lead; and they were wrapped in a similar manner to that described by Mr. Humphrey. They were about 30 feet long. He was rather inclined to agree with Professor Unwin as to lead joints. They took some trouble when these mains were first put down to set them up well, as they thought, and tested the mains to 60 lbs. pressure per square inch with air as they were laid—not having the gas compressors down he had to use air. When they put the gas on, however, they found they were losing 5000 cubic feet per hour; and when he figured out what this came to per annum, he had almost a sleepless night over it. They opened out joint after joint, and found that under this pressure, though standing over the hole, it was impossible to smell the gas; yet it was issuing to a very slight degree at every joint. So he had to court the Local Surveyor, and ask him to make as little fuss as possible, because every joint had to be opened up and reset. This done, the loss was reduced to 300 cubic feet per hour. It was the steam-roller that generally upset matters. He believed the joints, when the pipes were first laid, were sound; but when they came to knock them about with a 15-ton steam-roller, the lead was disturbed. Still, he believed an improved lead joint could be made to answer very well; and he meant to experiment in this direction. The remaining three miles of main were laid with screwed joints. Professor Unwin had said that all the equations were theoretical. How advantageous it would be to have some actual test! He did not suppose the mains they had at Nuneaton would be of very much use to Professor Unwin for testing purposes; but he was perfectly certain the Directors of the Company would be only too proud to place the plant at his disposal, if he wished it. Based on these rough figures of the actual gas passing a 3-inch main, he worked out (for an address he delivered to the Midland Association a little while ago) the fact that a 3-inch main, under 25 lbs. pressure, was capable of providing a duty equal to 2187 brake-horse-power-hours at its extremity. These figures did not compare with those Professor Unwin gave in Table VI., because this table was for producer gas supplied through a 6-inch pipe. But they emphasized the advantage they still had in coal gas, because from producer gas they got up to something like 24·7 lbs. pressure in a 6-inch pipe, 1290-horse power. So that with coal-gas they could obtain double the duty, and use a main one-fourth of that required for producer gas. There could be no question, therefore, that the Mond gas people would not trouble them very much. The President had referred to the necessity they would shortly realize—viz., gas would have to be supplied at 1s. 6d. per 1000 cubic feet—but, in his opinion, this 1s. 6d. would have to be turned into 1s. with some of them. If they were to compete with suction-gas plants, nothing else was open to them; and in connection with this matter, if it was not out of order, he would like to point out that, when they saw in the published figures of gas undertakings returns, works where the cost for coal per 1000 cubic feet ran out at 6d. up to 15d., and that the costs other than for coal ran from 15d. to 39d., these broad facts showed conclusively that there was a very great deal to be looked into.

Alderman Miles (Bolton) asked if Mr. Helps was so far satisfied with the results of his experiments from all points of view that he intended to carry the system any further and to any considerable extent.

Mr. Walter Hole (Leeds) said he should like to ask another question. What was the gas passed into of which Mr. Helps had given them the result in his test? Was it passed into a gasholder, or how was it measured at the other end?

Mr. Helps said the gas was measured on the inlet of the compressor; and it was calculated that what went in went out at the other end into the atmosphere. The only difference would be that which was attributable to leakage; and at that time there was practically no leakage. With regard to the question put by Alderman Miles, the experiment had been so satisfactory that he intended to carry it further. Now that they had this main at work, he was going to take the first opportunity to overhaul all the mains, and have them working at 18 or 20 inches as soon as ever he could. When they get to pressures of even 18 inches, they could get about 40 candles per cubic foot. At the present time, consumers were called upon to lay down a little plant for their houses and factories, to get pressure up to this; but why should not the companies give it to them? When they used these pressures, they could reduce the size of mantle and burner and fittings, and fit houses far more artistically. He had a burner in use at Nuneaton which gave 60 candles; and it was no larger than the globe of an incandescent electric light. These were directions in which they could work so soon as they accepted the doctrine of high pressure.

Mr. A. W. Onslow (Woolwich Arsenal) remarked that the subject was very interesting; and he could not refrain from speaking. The formula Professor Unwin had given was one they had needed for a long time, as it was necessary to bring the formula for the flow of gas up to date; and evidently they had been working somewhat in the dark. The question of pressures had, he thought, been drilled into them too much. In his younger days, "Keep down the pressure" appeared to be the law. It seemed to him that the question of high pressure was one of the most important that could be discussed at present. Small mains were desirable for economical reasons; and they had many other important advantages. Unfortunately, he had not had a formula until Professor Unwin had given it them for the flow of gases in pipes; and he had had to resort to tests made by himself to get the various pressures. A comparison of these with Professor Unwin's formula would be interesting. When it was remembered that at Woolwich they

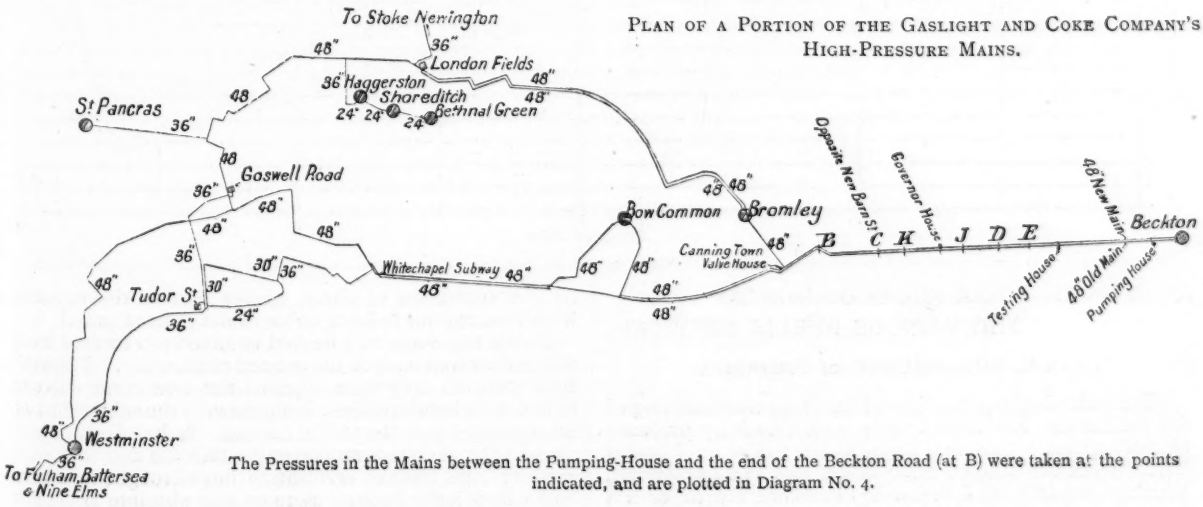
had to take from the mains a supply of gas for chemical, metallurgical, and lighting purposes at pressures of from 40 to 60, and even 70 inches, it was very difficult to obtain a proper method of gauging the flow of gases at these particular places in order to keep the pressures uniform, and at the same time get sufficient for the purpose. Considering that they had also to supply from a 10 or 12 inch main districts where the consumption had gone beyond the capacity of the pipes, it was necessary to feed those pipes from some source—either from the works or else from individual mains close at hand. He found that it was an economical way to supply the small service-pipes from the large mains by increased pressure. So far the pressure had only run up to 60 or 70 inches—certainly it was nothing to be compared with the 25 lbs. Mr. Helps mentioned—but he thought the time was not far distant when the whole of the mains would be under considerably more pressure than at present. They had one small main from the works under comparatively high pressure; and they found it very useful. Again, the question of cost came in very largely; and this affected them. By raising the pressure, the output was so much increased that the advantage could not be overlooked. They had not a main yet from the works to feed the subsidiary pipes (although this was contemplated), as the trunk main was large enough for present requirements. He had found small pressure stations particularly useful in other places. At the Woolwich Arsenal and other Government establishments, the same thing applied where the old mains had outrun the work. The difficulty was overcome by increasing the pressure generally; but, of course, one could go too far, because of leakages, in the case of old mains. The new high-pressure ones were of steel or wrought iron, with screwed joints; and the leakage need not be considered. He did not see why there should be more leakage in high-pressure mains than in low-pressure ones, if the joints were properly made. They ought not to look on this question in any way as being a formidable one, but merely as economical and inevitable. Not only was it a good thing in itself, but it had a tendency to raise the whole tone of their work altogether.

Professor UNWIN, in reply, said he should be very glad indeed if his very simple attempt to straighten out the theoretical side of the question of gas distribution proved to be useful to gas engineers. Something had been said about discrepancies of 3 or 4 per cent. between calculations from the formula and actual tests. These discrepancies would always occur, however good the formula they obtained, because, as he had pointed out, the coefficient of friction of different mains varied, and there was no scientific measure of the roughness of the inside of a pipe. They were obliged to select a coefficient which might not be exactly right. This difficulty could never be overcome. There would usually be a certain amount of discrepancy between the calculated and the actual discharge. With regard to bends, the actual resistance was rather a difficult question, only, happily, as many bends were easy bends, the resistance was not large. If they chose to put in elbows and tees, undoubtedly they got considerable resistance introduced. With easy bends, though they did not know exactly the resistance, they did know that the amount was comparatively small. It was very interesting to hear that the Gaslight and Coke Company had been distributing in very large mains at a pressure of 48 inches, and that they had adopted the system of feeder mains and distributing mains at different pressures. As he understood it, the main was something like 13 or 14 miles long, and the 48 inches of difference of pressure corresponded to about 3½ inches per mile; so that in this case they did not get a very long way towards the use of high pressure. Of course, 3½ inches per mile was not a very great pressure difference. He did not know that there was anything more he need say, except specially to thank Mr. Helps for his contribution to the discussion, and for his offer to render some mains available for tests. If he would accept any help he could give him, he should be very glad indeed to come down and assist him to make tests of his mains.

Mr. G. C. TREWBY has since sent for publication the following interesting statement: I regret that I was unable to be present at the reading and subsequent discussion of Professor Unwin's valuable paper; but, inasmuch as in his paper he expressed his surprise that no system of high-pressure primary mains connected with low-pressure distributing mains has been considered, I thought it would be a matter of interest to the meeting to submit a few diagrams bearing on this particular mode of dealing with the distribution of gas suggested by Professor Unwin, and which system of working was installed in the Gaslight and Coke Company's area of supply more than thirty years back—its inception being shortly after the commencement of the make and supply of gas from the Beckton works, and at the time when it was found that the gas pressure was not nearly sufficient to supply the yearly increasing quantity of gas to be made. The plan herewith shows the high-pressure system, starting at Beckton, where the gas is forced westwards by means of pumps at a maximum of 48 inches of water. The total hourly capacity of the pumps is equal to 4,200,000 cubic feet. It will be seen that two mains, each of 48 inches diameter, as the commencement of the high-power system, carry the gas from Beckton westwards; and, branching away from each other at Bromley-by-Bow, they extend—together with numerous cross-connections of various diameters—as far as Fulham in the west of London and Stoke Newington Common in the north. These mains are connected to the Company's manufacturing and gasholder stations, to which they either deliver gas for storage or from which the supply of gas can be supplemented. The bulk of the gas distributed from the high-pressure system passes into the low-pressure distributing mains direct by means of regulating governors at valve-rooms placed at convenient points over the Company's area of supply.

The experiments, the results of which are shown on the accompanying four diagrams (pp. 862-63), were made with a view of ascertaining the delivering capacity of portions of the high-pressure system referred to. No. 1 diagram indicates the actual, as compared with the theoretical, quantity of gas determined by Dr. Pole's formula, delivered by a 36-inch main slightly over a mile in length. The dotted

PLAN OF A PORTION OF THE GASLIGHT AND COKE COMPANY'S HIGH-PRESSURE MAINS.



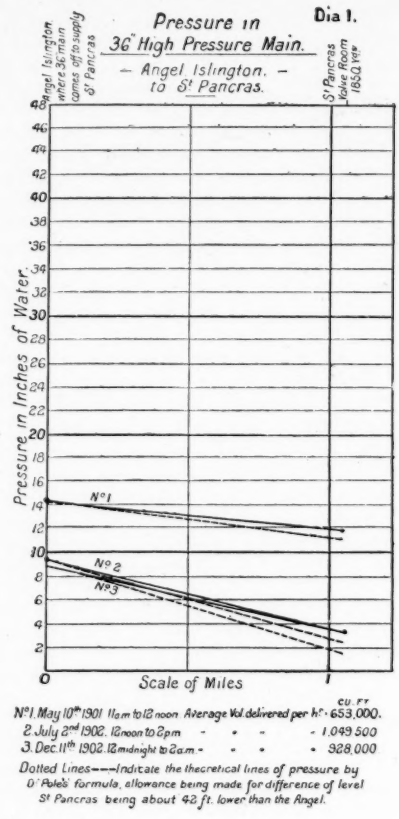
The Pressures in the Mains between the Pumping-House and the end of the Beckton Road (at B) were taken at the points indicated, and are plotted in Diagram No. 4.

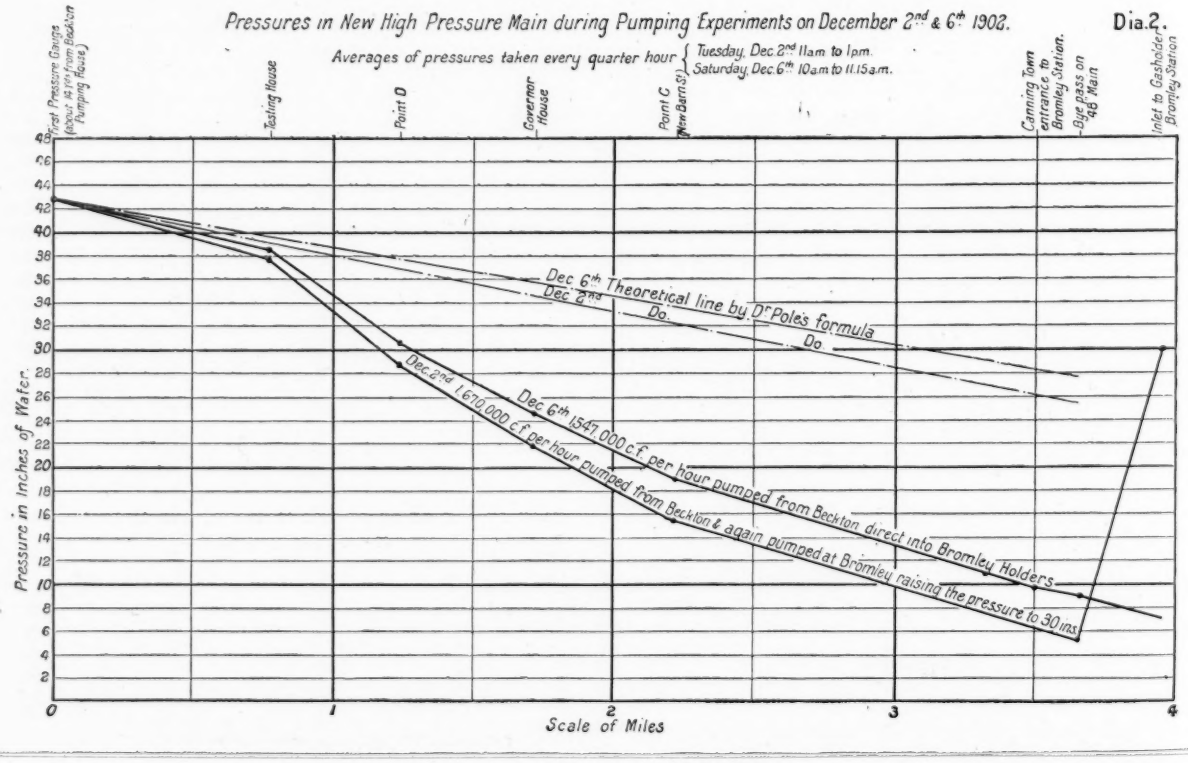
lines show the theoretical loss in pressure, which it will be noted is somewhat greater than that actually found during the course of the experiments.

The next diagram (No. 2) was obtained during experiments on pumping through a 48-inch main $3\frac{3}{4}$ miles long. The initial pressure was 43 inches of water; and Dr. Pole's formula, for the quantities delivered, showed a loss in pressure differing greatly from that found. The syphons along the line of main were kept pumped; but an examination of the pressures at several points along the line of main showed the pressure to be falling very irregularly. For the first 8-10ths of a mile, the line of pressure did not vary to any great extent from that indicated theoretically; but for the next mile-and-a-half the loss in pressure was much greater—lessening slightly as the end of the main was approached.

Nos. 3 and 4 diagrams also show similar variations, which were found to be due to accumulations of water in the main where subsidences had occurred between the syphons fitted on the line of main, the existence of which, up to the time of the experiments, had not been suspected.

The rise of pressure shown in diagram 2—from $5\frac{1}{4}$ inches to 30 inches—is interesting, as probably being the first instance, in this country at all events, of "boosting" on a gas-main. It is evident by an inspection of the diagram that the pressure at the point in the main taken as the termination of the extent of the experiment had fallen too low for the delivery of anything like the same amount of gas through a continuation of the same main. For the purpose of enabling the same volume of gas to travel onwards, an exhauster was put into action in the line of main, and run at such a rate as to maintain not less than 5 inches pressure on its inlet. The effect of this was, as the diagram shows, to raise the pressure again to upwards of 30 inches—a pressure which, of course, may be considerably extended, and thus practically to start the gas afresh on its journey through the mains, enabling their full capacity to be rendered available for the delivery of gas.


Dia 1.
Pressure in 36" High Pressure Main.
— Angel Islington. — to St Pancras.
Angel Islington where 36" main comes off to supply St Pancras
St Pancras Valve Room 1850 Yds
Pressure in Inches of Water
No 1
No 2
No 3
Scale of Miles
CU. FT.
No 1. May 10th 1901 11am to 12 noon. Average Vol delivered per hr - 653,000.
2. July 2nd 1902. 12 noon to 2 pm - - - 1,049,500
3. Dec 11th 1902. 12 midnight to 2 a.m. - - - 928,000
Dotted Lines — Indicate the theoretical lines of pressure by Dr Pole's formula, allowance being made for difference of level St Pancras being about 42 ft. lower than the Angel.

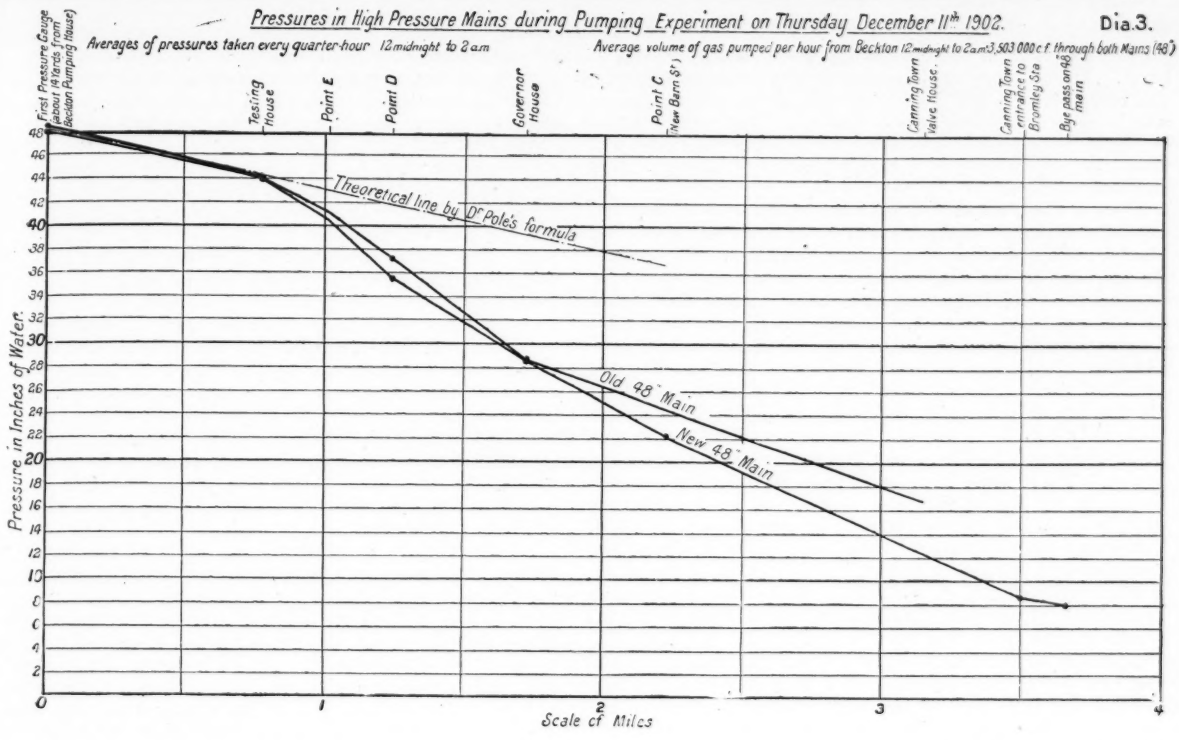

Pressures in New High Pressure Main during Pumping Experiments on December 2nd & 6th 1902.
Dia 2.
Averages of pressures taken every quarter hour { Tuesday, Dec 2nd 11 am to 1 pm. Saturday, Dec 6th 10 a.m. to 11.15 a.m.
Testing House
Point D
Governor House
Point C (New Barn St)
Canning Town entrance to Bromley Station.
Bye pass on 48" Main
Inlet to Gasholder Bromley Station
Pressure in Inches of Water
Dec 6th Theoretical line by Dr Poles formula
Dec 2nd Do.
Do.
Dec 2nd 1,670,000 c.f. per hour pumped from Beckton & again pumped at Bromley raising the pressure to 30 ins.
Dec 6th 1547,000 c.f. per hour pumped from Beckton direct into Bromley Holders
Scale of Miles

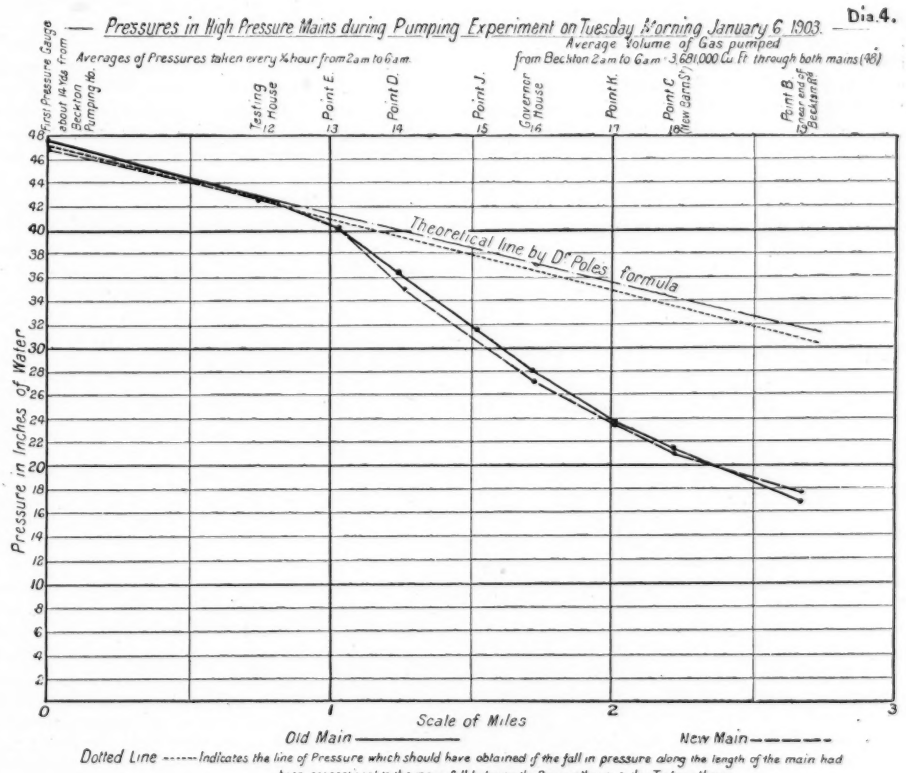
ROADWAYS: THEIR RELATIONSHIP TO THE VARIOUS PUBLIC SERVICES.

By A. E. BROADBERRY, of Tottenham.

[The following paper, prepared for the present meeting of the Institution, has been largely anticipated by evidence recently given before the Royal Commission on London Traffic; but the subject being of interest to all engineers, whether practising in London or elsewhere, the paper has been allowed to go forward, as it will afford an opportunity for the expression of views, on the part of the members, which cannot fail to be of value at the present time.]

Public roadways may be said to have been formed for the use and convenience of the general community. Primarily, their surfaces only were required for inter-communication between various localities; but gradually the subsoil has also been pressed into the public service. It has become occupied by the various arrangements which the demands of our modern high state of civilization have brought into being, and which have become more or less absolute necessities. This is particularly so in populous centres, whether they be


Pressures in High Pressure Mains during Pumping Experiment on Thursday December 11th 1902.
Dia.3.
Averages of pressures taken every quarter-hour 12 midnight to 2 a.m.
Average volume of gas pumped per hour from Beckton 12 midnight to 2 a.m. 3,503,000 c.f. through both Mains (48")
First Pressure Gauge about 14 Yards from Beckton Pumping House
Testing House
Point E
Point D
Governor House
Point C (New Barn St.)
Canning Town Valve House.
Canning Town entrance to Bromley Sta
By pass on 48" main
Theoretical line by Dr Pole's formula
Old 48" Main
New 48" Main
Pressure in Inches of Water
Scale of Miles


Pressures in High Pressure Mains during Pumping Experiment on Tuesday Morning January 6 1903.
Dia.4.
Averages of Pressures taken every ¼ hour from 2 a.m to 6 a.m.
Average Volume of Gas pumped from Beckton 2 a.m to 6 a.m 3,681,000 Cu. ft through both mains (48")
First Pressure Gauge about 14 Yds from Beckton Pumping Ho
Testing House 12
Point E 13
Point D 14
Point J 15
Governor House 16
Point K 17
Point C (New Barn St) 18
Point B (near end of Beckton Rd)
Theoretical line by Dr Poles formula
Pressure in Inches of Water
Scale of Miles
Old Main
New Main
Dotted Line ------ Indicates the line of Pressure which should have obtained if the fall in pressure along the length of the main had been proportional to the mean fall between the Pumping House & the Testing House.

business or residential areas. The only proper criterion for judging the degree to which each service has become indispensable is the extent of its use; and this should be the gauge of the consideration given to it. A public service may be of such a nature that the benefit cannot be measured out to each individual, as, for instance, in the case of making, maintaining, and cleaning the road's surface, in public lighting, or in carrying away the rainfall; or it may be of high importance to the community from a health point of view, as in the case of house drainage, and subsequent dealing with sewage, &c. Such matters, therefore, cannot be worked as commercial undertakings, and must be provided for by levying rates. On the other hand, a public service may be paid for by the individual user exactly in proportion to its use; and in such cases the administration is often in the hands of commercial companies.

The author wishes to state, as an axiom for the purpose of this paper, that whether the cost of service is of necessity defrayed by subscription to the rate-fund or is defrayed by ascertained exact liability, it is equally a public service, and should have proper provision made for it in the public road; and co-laterally one service should not be made to bear either directly or indirectly any part of the expense of any other. Yet, how often is any such provision made? If "Never" was given as an answer to such a question, it would not be far from the truth. Of course, in old roads there is some excuse, for even the formation of the road itself is mostly accidental. Many of such roads are neither straight nor of

even width; the chance position of some tree or swamp probably accounting for the strange freaks in the forming of them. Equally wayward influences may be responsible for the run of some old drains of prehistoric origin, and of which no record probably ever existed. So also with other works of more recent date, the haphazard arrangement has more the appearance of a happy-go-lucky chance than of any defined plan.

Even at the present time, with the advantages of improved organizations and modern methods, it is unfortunately too often a matter of scrambling between various public services for positions in the roadways. No one has any regard for anyone else, and frequently one public service encroaches on the works of another. Sometimes this is done quite unintentionally, from the mere fact that it is almost impossible to obtain any accurate records of the buried street works of the various services; or, if these be obtainable at all, they are only on very general lines—details being almost invariably missing. In new roads, too—say, those now being constructed—the builder puts in the sewer and surface drains. These must both be in straight lines between the manholes, so that, if the road happens to be curved, they usually cross and recross the road several times; the result being that the water-main has to dodge these manholes and trenches, and the gas-main to dodge the whole of them. It is deplorable that such a state of chaos should ever have existed, but far more deplorable that it should continue. One would almost think that no control exists. Nevertheless, Parliament has for many years realized that the interests of the ratepayers and general community must be carefully safeguarded in respect of any public service, and especially so when, from its somewhat speculative nature, it is undertaken by a commercial company.

The safeguard adopted by Parliament was the placing of the control in the hands of the local authority appointed for carrying on works which were not of a commercial nature, and which necessarily had to be met by public funds. Nothing better or more just could have been conceived at the time. The supervision consequently exercised, has, however, failed to prevent a very expensive confusion in the underground work in many streets, particularly in main roads, and roads which a few years back were little more than country lanes, but which, on account of development of populous districts, have become of almost equal importance. The words "expensive confusion" are intended to refer to the increased cost of all matters of public road work necessitated by encountering other works in all sorts of unexpected positions; they in their turn having probably been forced there by similar circumstances. For all this extra cost, the public—or that portion of it using that service—has to pay. In private streets, even public control has been missing, and private owners rarely trouble what position is taken.

The chief cause of the system having failed, is that, in operation, the control has never acted from a constructive standpoint. Up to a certain period, the controlling authority could act disinterestedly, or, as was more often the case, remain inactive, allowing the various services to take their own proposed positions irrespective of the positions of others. The worst that was heard was an occasional attempt to compel a trading concern, such as a gas company, in which we are mostly interested, to put a hard core bottom to a road which had never previously been so constructed—or, to speak more exactly, to that portion of it occupied by the trench; or an attempt to force the main to an expensive depth, adding directly and extensively to the cost of this particular public service. The author has been asked to lay all the gas-mains in one district at a minimum depth of 4 feet, merely to save a risk of a small additional cost to the service rendered by the steam-roller for repairing possible fractures.

This impartial attitude of the road anthorities was, however, doomed to be destroyed. In recent years, a great desire has sprung up among a considerable portion of the people for municipal trading; and many districts, counties, and boroughs have gone into business in gas, water, electricity, and tramways. In cases where all these public services are in the local authority's hands, it is possible that an impartial administration may still continue, and absolute justice be done between every service. But where trade rivalry is introduced, even in the slightest degree, it is impossible to prevent trading instincts from inducing a desire to place the rival at a disadvantage. Hence follows a destructive policy for which the public has to pay dearly, and confusion is likely to become worse confounded.

It is not by any means unusual in our own industry, when a new main is required in an old road and the gas engineer selects the line which he considers will be most convenient and economical, for him to be informed that the proposed line cannot be sanctioned because the local authority may themselves possibly require that site for a water-main or an electric cable at some more or less remote date; and the gas engineer has to take a new and more difficult line. The author does not in any way suggest that consideration and foresight should not be exercised; on the contrary, the controlling authority, as such, should see that, so far as non-speculative matters, such as drainage, &c. (which are directly chargeable to the rates), are concerned, commercial undertakings do their work in such a way as not to unfairly add to the cost of other public works. They, however, have no right, as traders themselves, to attempt to drive the other services which they are rivalling to greater expense and inconvenience in order to reserve for themselves the most favourable positions—thus heavily handicapping their competitors and taxing those who subscribe to that service.

As an instance to illustrate the effect of this spirit, the author could point to a case where recently a position under the footway was refused for a gas-main because it might some day be wanted for electric cables; and the haunches of the road being full, the gas-main had to be laid down the centre of the thoroughfare. Now a tramway is to be laid by the county, and the cost of removing the main to the position at first suggested must fall on the county rate, and though its individual effect will be too small to be felt in the fares charged, still in principle the effect is there.

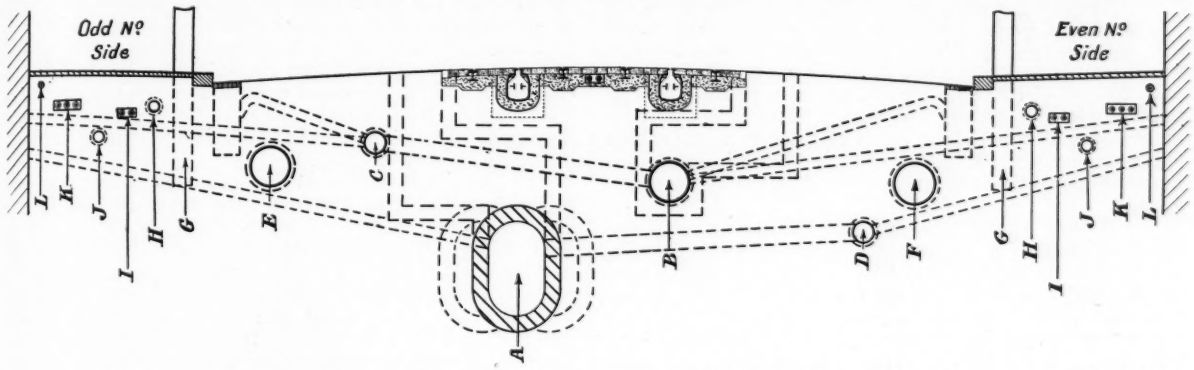
Undoubtedly it is difficult, but surely not impossible, to harmonize the conflicting interests in public road works. Water companies often object to a gas-main approaching nearer than 2 feet from any of their mains; and both gas and water companies dislike electric cables anywhere in their vicinity. Yet there is no simple power vested in either to prevent encroachment. There is, indeed, a crude and almost barbarous method to which the writer has occasionally had to resort—namely, the placing of a strong gang of men to work on the main, and so hamper the other work as to compel it to steer clear. Such methods are a disgrace to a civilized nation, but in the present state of the road arrangements, are the only effective weapons of defence.

The engineers who organize the work have no desire or intention of being aggressive to others. They select the route which appears to them to be most suitable and most free from obstruction. They prepare their specification, and let the work to contractors, whose sole object, however, is profit, and who do not scruple to encroach on the work of others, if by so doing they can get through their own more expeditiously. So long as no objection is taken, the engineer has no knowledge that any encroachment has occurred, and is well pleased that the work is progressing rapidly and without hindrance. Every additional work in any street makes the tangle worse; and though the past is past, it is worth considering what is being done as regards the future. At present, nothing—or very little. Mostly, things are allowed to slide as they have done in the past, though occasionally engineers in certain localities try to co-operate for mutual benefit and convenience; the result being greatly to the common good. Changes, however, are constantly occurring. Engineers attached to the various services come and go. New men who replace them may follow the old policy, if one existed, or they may strike out a new line for themselves and work it during their time with more or less vigour. But it is all as it may chance to be.

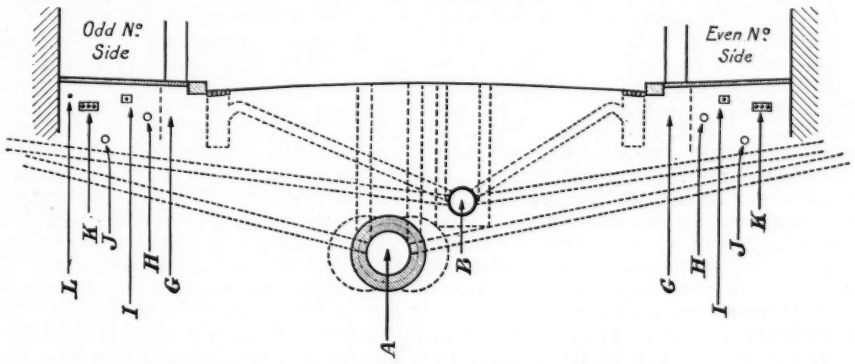
This paper has dwelt sufficiently on the dark side; and it is now time to look for some remedy, or at least some amelioration of the trouble. This undoubtedly is to be found in proper organization. Any system, however bad, is better than no system at all. Something is required above local control, which usually takes merely the form of veto, instead of constructive policy. It is a matter of national importance; and the organization must be national in its application, so that engineers of every public service, wherever located from time to time in the course of their career, should follow the same principle. Every consideration seems to point to the need of the establishment of Standard Road Sections. Naturally, the section which would be suitable for main roads would not

be suitable for side streets; but roads could be "classed" and treated accordingly. Say, for instance, the classes were 100 feet, 90 feet, 80 feet, 70 feet, 60 feet, 50 feet, and 40 feet roads, with a separate standard adopted for each, and rigidly adhered to throughout the country whenever a new road is made or an old one reconstructed. It would then be easy for every engineer—and for everyone else right down to the lowest workman in any of the public services, and in any town—to know precisely where his and every other work is situated.

Exhibited on the wall will be found drawings illustrating a suggestion for a 60 feet road and one 40 feet in width. It will be observed that the two sides of the road differ in both cases, and the different sides are distinguished as "Odd number side" and "Even number side"—referring, of course, to the numbering of the houses or buildings lining



Roadways, 60 Feet Wide.—A. Sewer. B. Surface-Water Drain. C. Intercepting Surface Drain. D. Intercepting Sewer. E. Trunk Gas-Main. F. Trunk Water-Main. G. Obstructions. H. Service Gas-Main. I. Telephone. J. Service Water-Main. K. Electric Light Cable. L. Fire Telegraph.



Roadways, 40 Feet Wide.—A. Sewer. B. Surface-Water Drain. G. Obstructions. H. Service Gas-Main. I. Telephone. J. Service Water-Main. K. Electric Light Cables. L. Fire Telegraph.

the roadway. In one or both will be found provision for the following services, enumerated with which is a list of accessories. The latter are not all shown on the drawings, for the reason that many of them are not continuous but only occasional, and can usually be accommodated in the space reserved immediately inside the kerb for "obstructive objects," by which is meant all kinds of trees, posts, and pillar-boxes, &c.

List of Public Services and Accessories.

Sewers.—Manholes, lamp-holes, ventilating shafts, house connections, &c.
Surface Drainage.—Manholes, gullies, house connections, &c.
Water Supply.—Meter-pits, valve-boxes, fire-hydrants, wash-out cocks, water-posts, house connections, &c.
Gas Supply.—Lamp-posts, syphons, valves, house connections, &c.
Telephone.—Inspection chambers, posts, &c.
Electricity.—Cables, inspection chambers, house connections, &c.
Hydraulic Power.—Valve chambers, house connections, &c.
Fire Brigade.—Alarm posts and wires.
Telegraph.—Posts, &c.
Post Office.—Pillar boxes.
Tramways.—High-tension cables, poles, service cables, transformers, inspection chamber, &c.

The last named service, taking up as it does about 15 feet to 16 feet of the centre of the roadway, should be compelled to be self-contained so far as its cables are concerned. It is illustrated constructed on the conduit system, with its feeder between the tracks, as, in the writer's opinion, its obstructiveness should be reduced to a minimum as its bulk is necessarily so great. Should, however, the overhead trolley wire system be used, the poles should be in the space reserved for obstructive objects, and centre posts should be strictly forbidden as being dangerous to traffic, and destroying the use of about 8 feet of the centre of the road.

The various requirements of present-day life represented in the list have gradually come into existence from time to time; and as they may probably extend and other services appear which will become equally required, some available space is reserved for the future. For curved roads, it will be observed, a limit of deviation is allowed in the case of sewers and surface drains. Every rule is said to have its exception, and no doubt occasionally some large culvert may cross the road, or some equally disturbing factor may operate to distort any rule of construction. But in that case the exact position of the intruder might be indicated by distinctive posts on each side, marked "culvert," "railway," or whatever the cause of variation may be. In the case of old roads, it would be impossible, in the ordinary way, to make them conform to the standard; and in these cases, the author would advocate marking the size, position, and depth of each underground work on tablets attached to lamp or other posts at intervals of not more than 50 yards, so as to maintain a public and indefaceable record.

No doubt the suggestions contained in this paper can be improved upon very considerably by engineers whose speciality is road construction; but it is presented in the hope that it may enable us to take a forward step towards an organized arrangement of roadways in their relationship to the various public services, and may help to ultimately put an end to the confusion and expense which at present hamper and dishearten all who are concerned in the construction and administration of public works.

Discussion.

The President said this subject had interest for all of them. In some parts of London there were pneumatic

dispatch pipes, and in others subways, adding two to the ten services enumerated by the author which had to be encountered. He did not know that the paper raised very many points for discussion, because their experience was all on the same lines. Its object was to suggest that there should be a system laid down, so that all parties conforming to it might be assured that when once they complied with it, they would not be lightly disturbed, and that if they were, they might naturally expect compensation. It was a subject to be ventilated; and perhaps they might pass some resolution that a co-ordination of these services was desirable, and that some impartial public officer should have control of it. It would not do to have the officer of some municipal authority who wanted to interfere with their undertakings. Such action was hardly ripe yet; but perhaps Mr. Broadberry would think it over, and bring it up at some future time in a shape in which it could be put in a concrete form.

Mr. HENRY TOBEY (Malton) said Mr. Broadberry had admittedly looked at the subject from the dark side entirely; and he thought he must also have looked at it simply from the Metropolitan side. He did not believe Provincial gas undertakings were in the position represented—they were not entirely under the thumb of the local authorities who had charge of the streets. He did not think it was usual for gas companies to submit plans of the way in which they were going to lay their mains. They took what course they considered desirable or necessary; and the urban authority had no more power in the street than the gas undertaking or any other concern that had statutory rights in the roadway. Any undertaking which had statutory rights at all could take its own course. It was under no obligation to adopt any particular route, and was not to be dictated to by the surveyor of the municipal authority.

The PRESIDENT remarked that, having been for some time under the impression that they were bound to conform to some extent to the surveyor of the road authority, he put the point to a very eminent Counsel, Mr. Danckwerts, who assured him that if the authority demanded a plan, they could get one; but before doing so, they must show that they had some works which the operations were likely to interfere with. The words of the statute which was incorporated in all their Acts were liable to a construction on the lines which Mr. Broadberry suggested; but, as a matter of fact, if they chose to test the question, he was assured by the very high legal authority he had mentioned that the public bodies had no right to dictate such a course, inasmuch as on their side they could say they were entitled to have a plan to indicate the way in which their works would interfere with, or give bad access to, some work already existing. Mr. Tobey was perfectly correct in saying there was a great deal of mistaken idea as to the rights over the road. The subsoil of the road did not as a rule belong to the road authority. It would only belong to them where they bought up the original estate, and in selling frontages on either side made a reservation that the subsoil should remain vested in the original vendor. The subsoil in the road belonged, up to the middle, half on each side, to the owner of the property abutting on the road. He could excavate it and put cellars in it at his own sweet will. If he had the virgin soil and put a cellar in, the authority would have to compensate him if they took the cellar away, or would have to go below him; and the gas company would have to dodge round about in some way, because he had his soil occupied by his property, and could not be disturbed. It was because the supply of gas demanded the right of invading this property for the common good, that the Acts of Parliament existed. If it were not for the privilege given to put the mains in private soil under the surface of the road, they need ask for no privilege; but as long as they did require the assistance from Parliament of having the right to go into the subsoil, they must subject themselves to parliamentary restrictions. The local authorities often thought the whole thing belonged to them. There was nothing so exaggerated as the self-importance of the officer of a local authority. Sometimes it was almost ridiculous; and many of them were under a false impression about this matter. It had been declared by the Courts that, if they had no parliamentary authority, the owner of the property on that side on which the pipe was put could go and smash it; and if they tried to go on the other side, the man on that side could smash it or make them take it away. This was laid down by one of the Superior Courts very early in his experience.

Mr. W. B. RANDALL (Waltham Abbey) said he might give his experience on this particular subject in connection with the question of reinstating roads. In country towns or villages, it was often the case that they had to excavate a road, and had 2 or 3 inches of hard core or gravel at the top, and underneath there might be clay. Oftentimes, the surveyor came round and said he should not allow them to put the clay back again, but they must bring clinkers or brick rubbish from the works; that he insisted on hard core; and he should give them an order from his Council to do so. Of course, one must protect one's own company with regard to any possible accident that might occur; but he should like to know if the President was right on the subject of reinstatement. The section was only too well known that they must reinstate and make good. How far this applied, he should be glad to know.

The PRESIDENT said what they could ask them to do was to reinstate the road with the same materials, and in the same condition that it existed before, to the very best of their ability. The regrettable thing was that they could not lay a main along a road, as he had done in country places, without the effect of the disturbance being visible for a whole year. They would often see exactly where a main had been laid the year before. It became a question, then, whether, if they were disturbing such a material as clay (which when once moved occupied a larger bulk than it did originally, and which they never consolidated as Nature did), it would not be wise to take the surveyor's advice, so to speak—whether it would not be bad to restore the stuff in the puddled condition in which it got when wet, and much better to substitute any cheap rough material they had. It was often necessary to fall in with such advice, although given in a very peremptory manner, and taking the shape almost of an order; but it was a matter for discretion. If they ran the risk of not being able to restore the clay in such a state that it would support the hard core at the top properly, so as not to get some heavy laden waggon with one of the wheels in up to the butt, they would be within their rights according to law; but, of course, in all these matters there was a point where discretion came in. The point now put was one in which they might often do good by adopting the suggestion of the surveyor. But take the case of the Commercial Company. They were now in a dispute which was threatened to be taken to the High Court. The surveyor said, because they were disturbing a very important road with pitched paving on the top of it, he should order them to put in concrete. This was much more expensive than rough material from the gas-works; and to put in what might cost them in a large works perhaps 10s. a cube yard, but in that place might cost £2 because of the small quantity required, was rather too much. The claim was therefore being resisted by the Gas Company under the advice of their Engineer; and the Directors had resolved to fight it because there were decisions already in existence to show that the matter had been dealt with by the Court.

Mr. J. L. CHAPMAN (Harrow) said that as a Suburban Engineer having to do with fourteen different Councils, he might say a few words on the matter. He was greatly in favour of paying the local authorities a certain amount of money to maintain the roads. This was a way of escaping all difficulties. His experience was that, if an arrangement were made in a proper manner, there was no difficulty in carrying it through; and the price charged was not excessive, compared with the cost of keeping the road in order. He therefore thought that it was a wise thing for every man connected with gas lighting to enter into an arrangement with the different Councils, and pay so much for repairing the roads. With regard to Mr. Randall's remarks on the repairing of a road, in many districts it was impossible to bring the road up to the original state unless a certain amount of hard core were put in under the gravel. The roads were often in a spongy condition; but they stood very well until they happened to be once opened, and then difficulties occurred. He believed, therefore, that in every instance it was the wisest thing to enter into an arrangement with the Councils. He had one—and only one—difficult man among the fourteen. He did not quite agree with the President's ruling about the Act, nor with the opinion given by Mr. Danckwerts. He believed they had to deliver a proper plan of the place where they were going to lay the main; and if the Council did not object, and give another plan, they could then go forward, unless there was an appeal to the Magistrates. His view was that they had

to present a plan; and if the Council did not formulate an alternative one, and there was no appeal to the Magistrates, they could go forward with their own proposal. The difficult man he referred to was Engineer to one of the largest Suburban Councils; and he believed the Gaslight and Coke Company had the same trouble with him that he himself had. There, his rule was to go forward. That was the only way he could deal with him. But he always took care that the road should be re-instated in the same condition as it was before; and he put in hard core, and put the road in perfect order. The question cropping up now in connection with Suburban Companies was that of the tramways. He was very much troubled through the laying of the Middlesex County Council tramways through his district; and it came to this—that it would necessitate in all cases both the water and the gas companies doubling their mains. It was impossible to lay services underneath the tramways with any comfort in country districts. He found it was more economical to put down a separate main on the other side of the road at the cost of the Company—charging the Council with the outlay necessary for altering the services and removing them to the new main, and also with the cost of removing the old main out of the way of the tramways and putting it in a position convenient for the services on that side of the road. They must maintain the Act of Parliament, and conform to it exactly, if they were going to carry on the work satisfactorily with the different District Councils.

The PRESIDENT said he thought there was really no difference between himself and Mr. Chapman. The opinion given to him was not so much as to the local authority having a right to know what the gas companies were going to do, as to dictating any alternative plan. They had no right to interfere with the gas company's plan unless they could prove to the satisfaction of the Justices that the plan would interfere with some work of theirs. Then they could ask the company to amend the plan, subject to an appeal.

Mr. BROADBERRY, in reply, said he thought they might congratulate themselves on the interesting discussion that had taken place. Nearly all the points raised had been answered for him by the President. He would like to say, however, that several of the speakers had indicated that they continued to do the work through their district practically at their own sweet will—they went where they liked, and did not care who was coming after them so long as they obtained the position they wanted to start with. He thought this was a thing that they and every other public service should avoid in the future. They should go on some recognized, organized plan, so that everybody knew where the different works were to be placed; and each one should respect the works of other people. If they did this, they would give a great deal more satisfaction, not only to themselves and others engaged in public work, but to the ratepayers and residents on the road.

ARTIFICIAL GAS ILLUMINATION IN RELATION TO NATURAL LIGHT.

By WILLIAM SUGG, Assoc.Inst.C.E.

Standing on the deck of a first-class P. and O. liner off the South of Spain, and looking towards the horizon line, the writer was one morning in the month of March watching for the first appearance of day. The stars were shining out of a sky almost black, with a brilliancy such as we never see in this country. In the clear air, the distance that the stars and constellations are above each other could be seen so distinctly that it seemed as though they were falling towards the earth. The horizon line was marked all round, at about 8 to 10 miles from the ship, by countless stars, magnificent to behold; there was no sign of day. But suddenly, in the east, a dim greyish light appeared close down on the horizon line. Gradually it extended upwards, becoming a slightly reddish grey; and then a dark red. Above this, the sky was a brighter red, which, passing through the shades of orange, brightened into yellow still higher, and from that to green, changing into blue, and finally passing through the shades of blue to violet, and deep violet highest of all. Finally, the disc of the sun appeared above the horizon in the red. The changes in colour the writer has mentioned all appeared in the regular order of the solar spectrum—not as shown generally in books, but vertically. The red ray rested on the horizon line, next the yellow, then a little higher the green, then the blue, and finally the violet and deep violet ray—all according to the degree of their refrangibility. The red was the least, and the violet the most refrangible.

Meantime, as these changes went on, the daylight increased gradually in the heavens, till the fully risen sun filled the sky with first a beautiful reddish, then a rich red light, and the newly-born day shone out in all its freshness and beauty with a soft orange yellowish light very grateful to the eyes. At this time of the day, to take a photograph would require a comparatively long exposure; for although the light is very suitable and refreshing to the eyes, its actinic power is very much lower than when the sun is at its meridian. As the day goes on, the actinic power of the violet ray increases in intensity, till when the sun is at its meridian, an exposure of the eightieth part of a second (or even less than that with a good lens) is sufficient to produce a perfect picture with a snapshot camera.

It is here necessary to observe that, although all the rays of light—both the heat rays and the chemical rays—are then in their fullest power, yet the great volume of yellow light which comes from the sun tempers all its rays, so that although the day is at its very brightest, it is not so trying for the eyes as it would be if the sun's light were perfectly white instead of yellow. But, after the sun has passed the meridian, the actinic power of the light begins steadily to decrease, until the sun is sinking once more below the horizon. The colours of the solar spectrum can generally be seen then, and for a longer time than at sunrise, and there is a beautiful soft light which would, however, require a long exposure to get a photographic picture, because it is a light with a comparatively small amount of actinism in it.

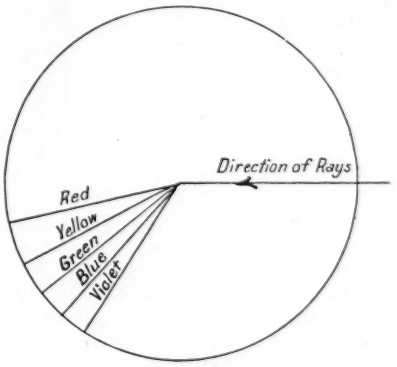


FIG. 1.

The solar spectrum is seen very perfectly on snow-clad mountains morning and evening; the violet and sometimes the red showing very large on the topmost peaks.

The actinic power of daylight in the summer is very much stronger than in the winter, when, even at mid-day, a photograph requires a much longer exposure.

Now if a ray of light passes through a globe of glass, or a molecule of moisture in the air, it will be seen that the red ray passes through the globe, almost through its centre; and it is possible if we could see it that the grey ray would be seen to pass through with a much slighter refracting angle. The orange ray passes through at a greater angle (as shown in fig. 1), the green at a greater angle still, then the blue, and the violet approaching as it deepens in colour to nearly a right angle.

In looking at the solar spectrum by passing a ray of sunlight through a prism, Tyndall said that there is an enormous ray of grey light at the red and the violet ends of the spectrum—comparatively bigger than any of the other rays. This grey ray is mostly invisible to the human eye; but it can be seen, no doubt, by cats and other animals, &c., with similar eyes. But, although invisible to the human eye, a little of the effect of both rays can be seen on specially prepared photographic paper. The ray at the lowest red end of the spectrum is the heat ray, and that at the violet or highest end the chemical ray, which most affects the sensitized photographic paper. Both these rays are an enormous volume compared to the other rays.

The undulations of ether are said by Periere to strike the eye the following number of times per second:—

Violet ray	699 billions.
Indigo	658 ,,
Blue	622 ,,
Green	577 ,,
Yellow	535 ,,
Orange	506 ,,
Red	477 ,,
Mean or white	541 ,,

The undulations of the yellow ray strike the eye 535 times, which is very nearly the same number of times as the white ray produced by the mingling of the other rays. It is quite impossible to realize the extent of these figures; but the comparison of numbers shows that the red ray is generally less fatiguing to the eye than the violet, because it strikes a lesser number of times than any of the other rays.

The eyes of owls, cats, and other similar animals, are specially prepared to receive the grey rays which strike the eyes much more slowly than the red ray does. Consequently, these animals do not seem to bear the full light of day without a very considerable contraction of the disc of the eye.

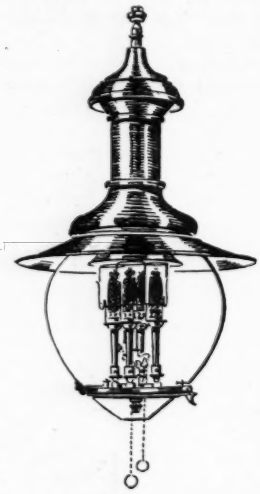


FIG. 2.

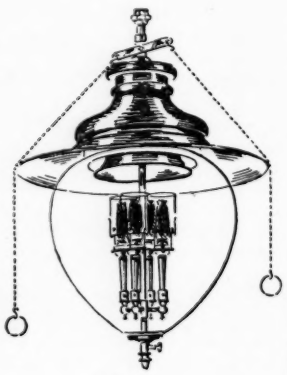


FIG. 3.

These facts and figures constitute a great object-lesson to those who have to provide artificial light, which is one of the principal vocations of this Institution. We must, to be successful, work in such a way as to imitate Nature; and therefore we ought to endeavour to get a light, like the light which we see in the evening, which is a good light, soft to the eyes and does not strain the sight. Even in the case of the meridian light, we have such a large volume of yellow light from the sun that the irritating actinic rays are very much softer than they otherwise would be. Then again, there is a green reflection from the grass and trees in the country, which, though not so much in town, softens the glory of the full day.

Reading out of doors in the strong full daylight is not suitable for human eyes, and generally induces sleep. But if the same power of light is made to pass through glass, the actinic power is very much reduced, although the glass may be clear. Therefore, in lighting schools, whether art schools or ordinary schools and colleges, it would be much better in the case of lighting for drawing, painting, or study to allow the gaslight to pass through glass; and this is specially so with regard to incandescent gaslight. If the incandescent lights are enclosed in a clear glass globe, the light is not so trying to the eyes, and more especially if it is enclosed in a properly shaped white albatrine globe.

Several sketches are given to indicate the way in which the writer considers that the lights should be made. The illuminating power of the lights may be 300 candles, low pressure, which for ordinary school work, is best reflected by means of an enamelled iron shade. The brilliant light of the burner is cut off by an albatrine cup, which does not prevent the reflected light from coming down, but makes it soft, altogether very powerful—very much like the light which we get after the sun has just gone down below the horizon. The difference between this light and the light towards the middle of the day, can easily be seen by taking a photograph of the scholars and books by daylight and gaslight. It will be seen that the exposure required to produce a good picture with the incandescant light in use will be considerably longer than that required for the daylight picture—proving that, although the gaslight is very good for any purpose, yet the amount of actinic rays in it are very considerably less than in daylight, and therefore less injurious to the eyes.

The late Mr. Gladstone, when his eyesight began to fail him, complained to writer about one of the "London" argand burners which was fixed in the Minister's room, over which an albatrine shade had been placed to throw the light down on the table. He found it very tiring to his eyes when reading, especially written papers. The writer explained to him what he thought was the cause of the fatigue, induced by reading under this light; and he recommended that a rose-coloured screen of silk should be placed on the albatrine shade, in the manner shown on the diagram, fig. 4, so that the upward reflecting rays might

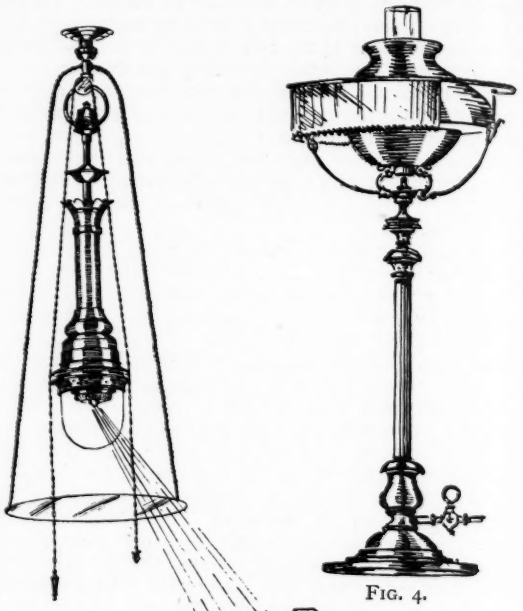


FIG. 4.

FIG. 5.

pass through the red light, falling on the eyes, through the rose-coloured silk, which would temper the slight actinism of the light. At the same time, the porosity of the silk would enable a current of air, induced by the heat of the burner and the shade to carry off the heat from the burner into the shade, and so prevent it from falling on the eyes and forehead. Showing the wonderful versatility of his mind, Mr. Gladstone so rapidly comprehended the idea that he said "Quite right. I now see why my eyes were so much more comfortable than usual when I was dining at a friend's house the other night. All the candles, which were placed at a certain height, above my head, threw down a rose-coloured light on my eyes, because they had ruby sconces." And he explained in a wonderfully lucid way, the theory of the effect of the rays of the solar spectrum, by which charming dissertation, the writer was much benefited. For a considerable time after this interview, Mr. Gladstone found great comfort in the light thus arranged.

H.R.H. Princess Louise used a ruby-coloured light in a lamp fixed in her boudoir for ordinary purposes (Diagram No. 7), but for painting the writer made her a special lamp, which was mainly devised by her Royal Highness. The difficulty was to throw a bright light on the picture the Princess was painting, and at the same time keep the light and heat from her eyes and her head. The Princess had an idea for a suitable lamp, a sketch of which she on one occasion drew for the writer in the studio. The

light was required to be yellowish white, and to fall on the picture, while the eyes were protected from it. The lamp which the Princess devised was as shown in fig. 5, and this was fitted with green glass to protect her eyes from the downward heat of the gas and the brightness of the regenerative burner, which was giving about 160 candles. The Princess then passed the writer her pencil, and he sketched in the lamp as it now appears.

The writer has found by experience that there are certain eyes for which the rose-tinted silk does not afford that degree of comfort which it does to others. For these, shades of green are more restful.

It must be said that at present there seems to be a growing tendency to make the incandescent lights too white—more like the light reflected from the surface of the moon, which is very trying to the eyes in countries where it is strongly luminous. Some of you will doubtless remember the quotation from the Psalms—"So that the sun shall not burn thee by day, neither the moon by night." It is evident from this that the light of the moon is harmful, at least in Eastern Countries, where it is stronger than here.

What is wanted is that the rays of light from the incandescent burner should be the colour of the sunlight, and not the colour of the moonlight.

We are only now beginning to find out that certain of the rays of light exercise a baneful effect upon the human body, although some of them are beneficial. Therefore, we want an artificial light without any of these baneful rays in it. The author feels certain that incandescent gas-light will provide what we want in this direction, if proper lighting apparatus is used.

For lighting schools it would be better to use incandescent lights with enamelled iron reflectors, and suspend the lights about from 12 to 14 feet from the ground; so that the scholars writing or studying beneath them do not see the actual light. If just round the burner (which should be from 100 to 300 candle), there was provided a properly shaped cup, made of albatrine glass, the light would be very much better for the students, without decreasing the reflected illuminating power.

In art schools for shading from the cast, the best appliance to employ would be a burner capable of giving a light equal to 400 or 500 candles, because the shadows on the cast would be from one point only, and therefore would be truer to Nature than they are when the lights are made up of a cluster of ten or a dozen fish-tail or flat-flame burners, arranged in a circle under a cone. Each of these burners throws a different intensity of shadow, according to its distance from the object or model that the students are drawing from.

The writer has seen work done by pupils beneath this grouping of fish-tail burners, which, by the way, do not give

FIG. 6.

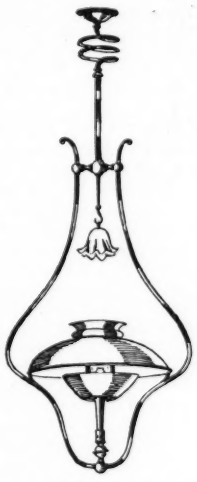


FIG. 7.

FIG. 8.

FIG. 9.

FIG. 10.

a sufficient amount of light, and it is very unsatisfactory, there being as many shadows on the cast as there are burners, and all differing in degrees of blackness instead of one graduating from a deep shadow. Even when lighted by a single burner, which would give about 500 candles of light (high pressure), the ordinary shades are too crude, and it is customary to put a couple of plain wing reflectors, as shown in drawing No. 8, to soften down the hard shadows. For ordinary drawings in the art library of South Kensington, the lighting is done by some large

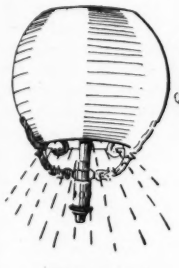


FIG. 12.

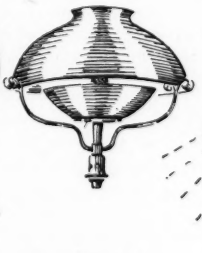


FIG. 11.

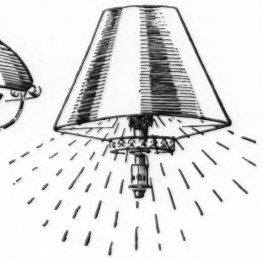


FIG. 13.

electric arc lamps placed close to the roof about 20 feet above the heads of the students. Over the desks where the art books are examined, and where drawings and painting are made from books, there are clusters of four small incandescent electric burners hung over the heads of the students at a height of about 5 or 6 feet. The combined lights give about 60 candles. This is not nearly good enough. The variations of the light from the electric lamps are very great—at times sinking down to almost no light at all, then suddenly rising in a manner that is very disagreeable to the students. If the lighting had been done by incandescent gas light of 300 or 400 candle power, hung at about the height of 10 feet, the light would be very much more effective and more suitable for the work.

The light most suitable for students who have to study Arabic, Persian, Sanskrit, Greek, and the old German characters is shown in figs. 8 and 13. Many students use candle light for this work, or a small fish-tail light unshaded by any kind of glass. Working by candle light, the strain on the eye is so great and the small light so dazzling, that unless the student has very strong eyes, it is impossible for him to read the very small characters and the fine lines and dots, which must be seen clearly in order to make out what the word really is. In a very short time, the student has to take to spectacles, when if he had a light properly shaded, the sight would be preserved, and the strain on the mind as well as on the eye, would be taken off. The writer has known great Oriental scholars, who have nearly lost their sight through having to work in strong sunlight in order to decipher some of the old manuscripts, without any protection to their eyes from the actinic rays.

There is evidently a disposition on the part of some of our school authorities to improve the lighting; but it is clear from the discoveries which are being made now, of the effect of different qualities of light upon the human system, that the whole matter wants carefully studying in relation to lighting, so as to get the most suitable light without any of the rays which are harmful to the eyes.

Of course, it is impossible in the limits of a paper to treat the whole subject as fully as it deserves to be, but the object of this paper is mainly to draw attention to the danger to the eyes by increasing the power of the light, without taking

means to guard them and even the skin of the face from the effects of those rays, which are deleterious.

The PRESIDENT said this was not a paper which would provoke any discussion. They owed very much to Mr. Sugg; and in his present contribution, although he commenced with a great deal of poetic imagery and artistic taste, and described how he found himself in the presence of a great Statesman, and on another occasion borrowed a pencil from a Princess to illustrate the charming design which was shown on the wall, still he worked out the paper to a very useful practical end, pointing out that they must protect their eyes while making use of his fine burners. Mr. Sugg agreed with them that there could not be much discussion on the paper; but the members would all acknowledge its value.

PERSONAL.

At the meeting of the Society of Civil Engineers of France last Friday, Mr. CHARLES E. BRACKENBURY, Assoc.M.Inst.C.E., of the Continental Union Gas Company, Limited, was elected a full member. Mr. Brackenbury has had considerable experience in connection with the management of gas undertakings on the Continent; and we congratulate him on being placed upon the roll of so distinguished a Society as that into which he has just been admitted.

Last Wednesday, the Middlewich Gas Company celebrated their Jubilee by a dinner in the Centenary Schools, in which past and present Directors and shareholders joined. An interesting feature of the gathering was the recognition of the services rendered to the Company by Mr. THOMAS HULME, who last March resigned the position of Secretary, after holding it for about 44 years. It took the form of a presentation, consisting of a silver tea service and rose bowl from the Directors and shareholders, and a gold-mounted umbrella from the officials and workmen. In acknowledging the gift, Mr. Hulme referred to the early days of the undertaking, when the works were let for £114 per annum, and the consumers numbered 35, compared with about 350 now.

OBITUARY.

On Monday last week, the death occurred at Lichfield, at the advanced age of 87, of Alderman SAMUEL HAYNES, who was connected with several important undertakings in the city and district. Deceased was born at Shareshill, Wolverhampton, and in early life was employed in the gas-works of that town. He removed to Lichfield 61 years ago, in order to take the management of the gas-works there. He became a Director of the Gas Company in 1876, and was connected with the undertaking until his death. At a meeting of the Directors on Tuesday, the Chairman (Dr. H. M. Morgan) alluded in feeling terms to the loss they had sustained by the death of Alderman Haynes, whose services were, he said, highly appreciated by his fellow-Directors and the shareholders. Deceased was deeply interested in the municipal life of Lichfield. He entered the City Council in 1880, and in 1886 was made an Alderman. He was Sheriff in 1884 and 1885, and Mayor from 1889 to 1900. Before commencing the business at the Council meeting on Wednesday, the Mayor (Mr. T. Andrews) paid a tribute to the memory of their deceased colleague, and moved a resolution expressing their regret at his removal from among them. Alderman Fowler, speaking in support of the motion, said it was due to the perseverance and energy of Alderman Haynes that the Gas Company was rescued from its deplorable condition in the days when gas was 7s. 6d. per 1000 cubic feet. The resolution was passed in silence, and a copy ordered to be forwarded to the family of the deceased. The funeral took place on Thursday, at Leomansley, and was attended by representatives of the undertakings with which Alderman Haynes had been associated.

Large Gasholder for Sheffield.—The contract for the important gasholder, tenders for the construction of which were recently advertised in our columns, has been awarded, we understand, to Messrs. Samuel Cutler and Sons, of Millwall. The holder has been designed by the Company's Engineer (Mr. J. W. Morrison), and is to be of a capacity approximating 8 million cubic feet. It will consist of four lifts, of which the outer one is to be 247 feet in diameter; and they will rise to a total height of about 166 feet. The design contemplates the inner lift rising free above the level of the guide-framing, which will be constructed of steel throughout, and consist of 28 vertical standards braced by a system of stiff diagonals and horizontal girders.

A NEW BURNER WITH FORCED DRAUGHT.

By A. LECOMTE.

[A Paper presented at the Meeting of the Societe Technique.]

As pointed out in a paper read before the Society in 1899, the problem of intense incandescence of a mantle heated by gas lies in effecting the combustion, underneath the mantle, of the maximum quantity of a properly-adjusted mixture of air and gas, producing as short a flame as possible. In the case of ordinary incandescent burners working at the usual pressure, the ratio of gas to air is 1:3 to 3·5; the chimney supplying this air to the flame and the yield from the burner being almost entirely independent of the pattern of chimney under normal conditions of pressure. The gas consumption per carcel-hour is from 17 to 18 litres for the small or "baby" burners, and 13 to 14 litres for Nos. 2 and 3 In these burners, the size, or rather the volume, of the mantle is proportioned to the hourly consumption of gas. If the brilliancy of the mantle—*i.e.*, the light per square centimetre—be measured, almost the same value is obtained in the cases of the burners from the "baby" up to No. 3. The latter has a mantle 130 mm. in height—a dimension which cannot be exceeded, owing to the nature of the refractory oxides—and gives usually 12 carcels for 150 litres of gas. To obtain a still stronger light, another method of combustion must be adopted.

In proceeding to increase the light of the mantle, we bear in mind the fact already pointed out, that for ordinary burners the consumption per carcel-hour improves as the burner consumes more gas. Thus, 18 litres are necessary in the small burner; but not more than 13 litres in No. 3 size. This is accounted for by the fact that proportionally to the volume of gas consumed, the surface cooling the gas is less in the latter than in either the small or the No. 1 burner. Hence the practice of intensifying the action of the burner by increasing the quantity of gas properly consumed under the mantle. Such practice is confirmed by the following experiment: A No. 2 burner, correctly regulated to a pressure of 40 mm. and with a 22 cm. chimney, will be found to have a lighting value of 8 carcels when burning 115 litres—*i.e.*, 14·4 litres per carcel-hour. It is easy to show that, except by changing this adjustment, the lighting power of the burner cannot be increased by any chimney placed above it. If, on the other hand, preserving the pressure of 40 mm., the consumption be raised to 180 litres, the flame escapes from the sides of the mantle, and the light is less. If now, at this new consumption, a suitable tall chimney be affixed, the flame withdraws into the interior of the mantle, and the lighting power rises to 14 carcels, and the gas consumption per carcel-hour falls to 12·8 litres.

Intensification of the light in this way is limited to 25 carcels, and a consumption for each carcel-hour of 12 litres of gas. There is, however, a means of increasing the light of the mantle while also decreasing the gas consumption, and that is the production of the gas at greater pressure by means of exhausters, as suggested in 1899. With the Lecomte exhauster, a burner in the Paris Laboratory gave 35 carcels for 315 litres of gas, equal to 8·75 litres for each carcel-hour. The lighting on this system of the gardens of the Paris Exhibition in 1900 was done with a Farcot extractor; and in another part of the Exhibition with the Lecomte exhauster. But the method was not used extensively—not because of its results, but from the complicated nature of the system. The results obtained with the burner to be described later are satisfactory as regards gas consumption, there is no mechanical complication, and the lighting power is precisely double. These advantages are secured by a chimney.

Considering for a moment the action of the chimney in producing a draught, it will be seen that when it is filled with hot gas at a pressure less than that of the atmosphere, its normal draught is increased. The following table shows its theoretical action in this respect. The "draw" of a chimney is the reduction of pressure at its base, measured by the difference in weight between the column of warm air in the chimney and a similar column at the ordinary atmospheric temperature. The heavier cold air exerts a pressure at the base of the chimney, and enters there with a velocity dependent on the temperature of the gas in the chimney and on the height of the latter.

TABLE *showing the Pressure (in Millimetres of Water) at the Base of a Chimney of Given Height and Mean Temperature.*

Mean Temperature of Interior of Chimney.	Height of Chimney in Centimetres.				
	20	25	40	50	70
300°C.	0·1285	0·161	0·257	0·322	0·450
350°	0·1400	0·175	0·280	0·350	0·490
400°	0·1490	0·186	0·298	0·372	0·522
450°	0·1540	0·192	0·308	0·385	0·540
500°	0·1580	0·197	0·316	0·395	0·553

Knowing the pressure in water units at the foot of the chimney, we can calculate the velocity of the entering air.

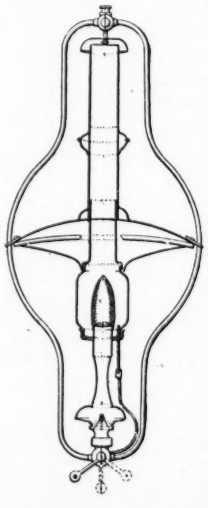
TABLE *giving the Velocity of the Air (at 32° C.) in Metres per Second.*

Pressure.	Velocity of Air.
0·1 mm.	0·441 metre.
0·2 ,,	0·582 ,,
0·3 ,,	0·712 ,,
0·4 ,,	0·822 ,,
0·5 ,,	0·920 ,,

The tables show that the temperature of the gas ranks equal to the height of the chimney in importance. As the second table indicates, the velocity of the air entering the chimney increases only as the square root of the pressure. With four times the pressure, twice the volume of air is admitted.

In my paper of 1899, I laid down in connection with intensified incandescent burners, the following propositions: Whatever the burner, and with either the gas only or with both gas and air, under pressure, as soon as the carcel-hour is obtained at a consumption of less than 10 litres, the proportion of air to Paris gas should be 5 to $3\frac{3}{4}$: 1; the pressure under the gauze should be 0·8 mm. of water; and the velocity of the outgoing gas, already heated in the mixing-chamber of the burner, should be 5 to 6 metres per second. These figures still hold good. When using the ordinary gas pressure, which may vary from 40 to 60 mm., in order to obtain the air necessary for the combustion, it will be found that the mixture rarely exceeds the pressure of 0·5 mm. to 0·6 mm. in the case of an average mixture of four volumes of air to one of gas. If the gas cannot be compressed, the only other resource is a chimney, the advantages of which are its cheapness and freedom from complication. Its serious drawback, however, is that it calls for an almost perfectly constant quantity of air. If the consumption of gas increases, the injector supplies additional air; and though the efficiency is not so good, yet it is very fair. But if the gas supply falls, the chimney draws air with undiminished force, the flame traverses the interior of the mantle without touching the refractory tissue, and the lighting power falls off considerably. For this reason the injector, and not the chimney, should be the chief agent in an intensified burner; and it is on this theory that the burner of the Société Française de Chaleur et Lumière is based.

The new lamp (which answers roughly to M. Servier's description of the original Clamond burner), consists, as will be seen by the diagram, of a bunsen burner designed to draw in the maximum quantity of air. The mantle is protected by a globe or cylinder of glass, and the whole is surmounted by a metal attachment forming the chimney. The bunsen is on the principle of the Kern burner, described by M. Lichtfousse at the Congress of the Society in 1901; the form of the mixing-chamber giving a very powerful flame. The glass reflector and the framework are substantially made, and can be easily taken apart and put together again. The glass-holder has a small hole for the lighting-tube, and there are also some minute circular apertures for the purpose of supplying from one to two volumes of air for the complete combustion of the gaseous mixture, and of ensuring combustion in the interstices of the mantle itself. Note should be taken of the fact that the lighting of these burners, in which from 350 to 1100 litres of gas are consumed per hour, should be performed with much greater care than is usually taken; otherwise the mantles will soon be ruined. To this end, the tap is a three-way one. The gas is directed first into a small bye-pass, at the extremity of which it ignites; then, on the tap being further turned, it goes into the principal supply-tube, on emerging from which it is ignited by the pilot flame; and, finally, on the tap being still further turned, the flash-light is extinguished.



The lamp is made in three sizes, consuming 350, 650, and 1100 litres of gas per hour. These patterns reach their maximum efficiency at 60 mm. pressure and with a chimney 40 cm. in height. For towns where the pressure varies from 25 to 35 mm., another model is made, the draw of which is greater in defect of gas pressure.

The mantles contain more oxides, and are much stronger, than those ordinarily used; and assuming that these more solid mantles become less luminous, though they last longer, the tests made on the behaviour of the burners are still more interesting. These tests, undertaken on the invitation and in the presence of M. Jean Delamotte, the representative delegated by the Society, were instituted not only to ascertain the properties of these burners, but generally the advantages of the principle on which they are based—viz., the greater part played by the ejector, compared with the chimney, in the formation of the combustible mixture. Besides the photometric tests, estimations were made of the oxygen in the mixture of air and gas. For this purpose, a small tube was soldered to the mixing-chamber, and the sample drawn off was analyzed in the Vignon apparatus. With suitable precautions, a sufficiently exact estimation could be made. The quantity of air was calcalated on the basis of 20·8 volumes of oxygen representing 100 of air. The following are the first results:—

Intensified Burner, Consuming 650 Litres of Gas per Hour.

—	Pressure.	Consumption of Gas.	Intensity.	Consumption per Carcel-Hour.	Volumes of Air per Volume of Gas.
Without glass and chimney .	70	625	35·1	17·80	4·85
With ,, ,,	80	648	74·5	8·94	5·89
	60	560	47·2	11·85	5·00
	40	458	25·6	17 90	4·60
Ejector (low pressure)—					
Chimney No. 1	30	680	40·5	16·80	4·60
,, No. 2	30	675	61·9	10 90	4·80

The tests show that on lowering the pressure 25 per cent., the air is decreased by 15 per cent. The efficiency for this large difference in pressure is still less favourable.

The height of the chimney can be varied in inverse ratio to the pressure. With a height of 38 cm. for 30 cm. pressure, the gas consumption per carcel-hour is 16·80 litres for a ratio of gas to air of $\frac{1}{4\cdot6}$. But on raising the chimney only 8 cm.—a very small amount—the ratio of gas to air becomes $\frac{1}{5\cdot6}$. On reference to the table of pressures already given, it will be seen that an increase of 8 cm. in the height of the chimney, at a temperature of 400° C., gives an increase in pressure of 0·06 mm. at the base of the chimney, an increment which raises the velocity of the incoming air by 9 or 10 per cent.—that is, we get 18 per cent. of air. The preponderance of the injector and the bunsen is clearly shown in these figures.

Similar tests made on the Kern burner—a powerful bunsen used without a chimney—show that it is equal to burners with a chimney as regards the gas consumed per carcel-hour.

—	Pressure.	Consumption of Gas.	Intensity.	Consumption per Carcel-Hour.	Volume of Air per Volume of Gas.
Kern burner No. 3, without glass	60	125	10 80	11·60	4·9
	50	113	9·63	11·72	,,
	40	104	8·92	11 65	,,
	30	87	7 13	12·20	4·8
Same burner, ejector at low pressure, without glass .	25	106	6·60	16·10	4·6

The following table gives the results obtained with the 350 litre (No. 1) and 1100 litre (No. 3) lamps:—

—	Pressure.	Consumption of Gas.	Intensity.	Litres per Carcel Hour.	Height of Chimney.
Lamp of 350 litres . . .	40	380	31	12·25	20 cm.
	40	390	44	8·88	38
	60	410	44	9·32	20
Lamp of 1100 litres . . .	50	930	100·8	8·60	40
	40	1,050	90·6	11·58	40
	70	1,030	121	8·52	40

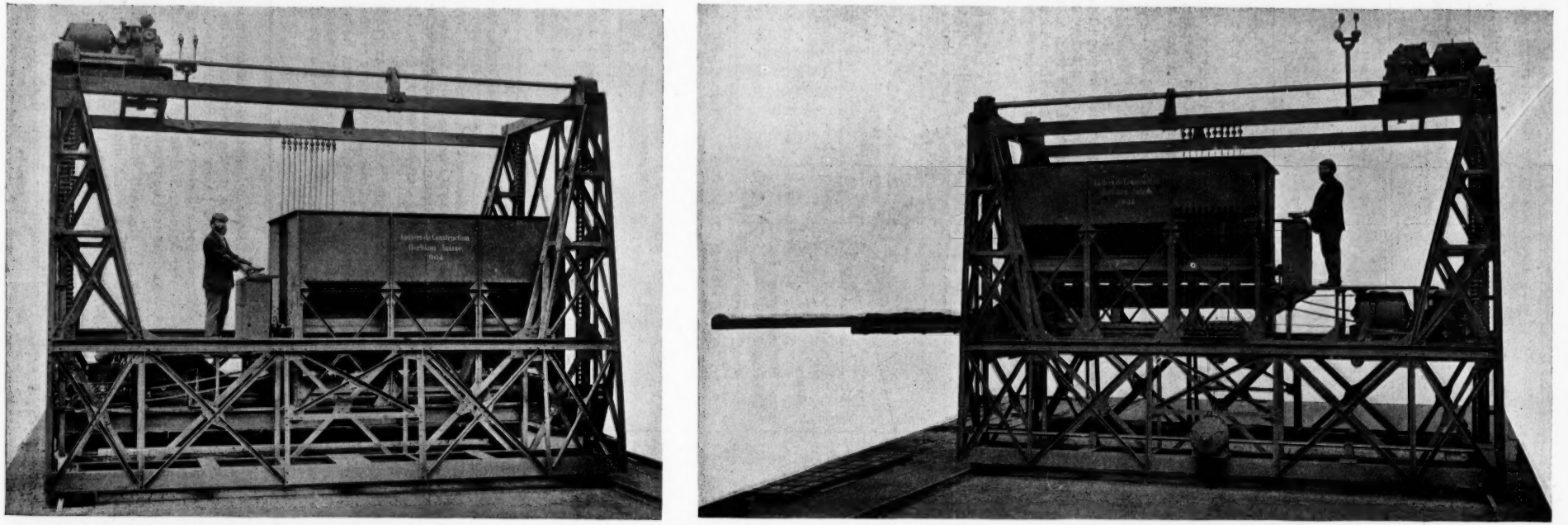
By using a reflector of suitable curve and angle, an excellent distribution of light is obtained. A series of tests on a 650-litre burner showed 68 carcels in the horizontal direction, 63·20 carcels at an angle of 20°, falling to 17·8 carcels in the vertical direction. Such distribution, in consequence of the greater "carrying power" of the horizontal rays, ensures a very even illumination in small rooms.

In conclusion, no comparisons need be made except to indicate that the new type of burner effects an economy of from 35 to 50 per cent. compared with ordinary incandescent burners; while compared with arc lamps the economy is 80 per cent. There is the further advantage that the system provides lamps of from 400 to 1200 candle power.

The Manchester and District Junior Gas Association will hold a meeting next Saturday, when, on the invitation of the President (Mr. W. Hill), a visit will be paid to the Stalybridge Corporation Gas-Works. Wagonettes will afterwards convey the members to the reservoirs of the Ashton, Stalybridge, and Dukinfield Joint Water-Works, where tea will be provided.

The Award in the Hucknall Huthwaite Arbitration.—In the paragraph on this subject which appeared in the "JOURNAL" last week (p. 727), it was stated that the value put upon the Gas Company's property by Mr. J. H. Brown, of Nottingham, was £2990. On referring to the minutes of evidence, we find that this figure was the gross value, subject to deductions which witness mentioned. These brought the amount down to £2005 13s. 7d. The award, as already mentioned, is altogether £5192.

THE BERTRAND-OERLIKON RETORT CHARGER AND DISCHARGER.



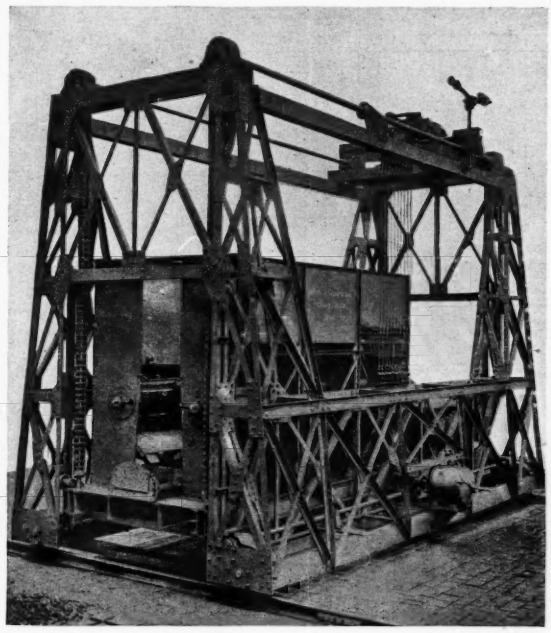
VIEWS OF THE MACHINE FROM OPPOSITE SIDES.

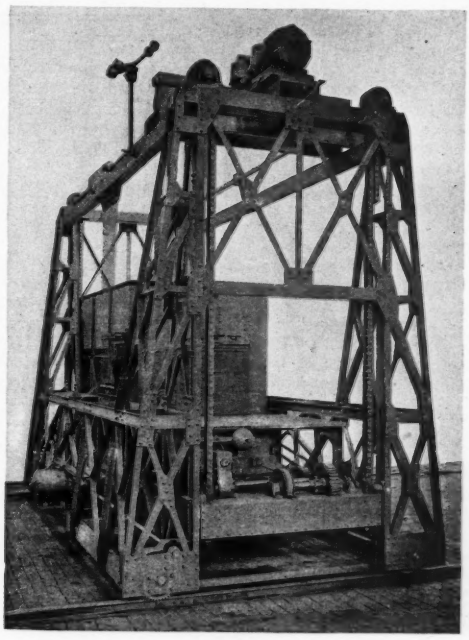
At the Meeting of the Société Technique du Gaz en France last week, a paper describing the retort charger and discharger devised by M. Bertrand, the General Manager of the Paris Gas Company, and constructed by M. Oerlikon, of Zurich, was read by M. THELLIEZ. The following are the principal portions of the communication, which was accompanied by the illustrations here reproduced.

The machine is constructed to make three independent movements: (1) The drawing and charging of the retorts; (2) the raising of the appliance to their respective levels; and (3) the longitudinal motion from one setting to another. The operations of drawing and charging are effected by means of a scoop with movable bottom. It consists of two parts—the upper being the frame and the lower the bottom. The two parts may be manipulated either together or separately. In order to push the coke out of the retort, the end of the scoop has upon it a shield turning upon a horizontal axis in such a way that when the upper part of the scoop is drawn from the retort, the shield slides over the charge which has just been deposited. The coal for filling the scoop is contained in two hoppers mounted upon the machine. They have a combined capacity of 60 cwt.; and by means of regulating mechanism, the quantity of coal allowed to fall into the scoop may be varied from 3 cwt. to $3\frac{3}{4}$ cwt. The bottom of each hopper is closed by a cylinder having four flaps furnished with a bolt. When the frame returns after its run into the retort, the bolt opens automatically, and the two cylinders make a half turn, by which the scoop is filled.

The charging operation is performed as follows: The machine having been brought up in front of the setting, the operator turns the releasing handle in the direction indicated. Thereupon the engine which works the scoop is started, and transmits its motion by means of an endless screw to two toothed wheels which gear into a single pinion. During the operation, these are engaged or disengaged automatically, and thus transmit motion to the cams of the endless chain to which the bottom of the scoop is attached, and also to a drum upon which runs a cable fastened to the upper part of the scoop. The toothed wheel imparts to the scoop a speed of about 33 feet per minute; and the forward motion continues until the lever actuated by the releasing handle returns automatically to its original position. This stops the scoop when it has been inserted ar enough into the retort. At this moment the frame is automatically bolted, so that the upper part of the scoop cannot be drawn out unless the bolt is again liberated. The handle is then manipulated to effect the return movement; the result being the reversal of the motion of all the mechanism. The bottom of the scoop slides from beneath the frame, and in withdrawing itself allows the coal to fall upon the floor of the retort. As soon as the frame has made its return movement, the bolt of the cylinders is drawn, the cylinders turn, the scoop is filled with coal, and the starting lever returns automatically to its position of rest. It will thus be seen that the manipulation of the appliance by the workman is a very simple matter; and the entire operation only occupies one minute.

The second movement of the machine is to bring it up to the level of the different retorts to be dealt with. This is effected by means of raising mechanism. The scoop and the portions of the machine by which it is operated, together with the two coal-hoppers, are mounted upon a platform suspended by four endless chains. Working at a speed of rather more than 6 feet per minute, it is easy to stop the platform at exactly the height required. Movement is imparted to it by an engine fixed on the





FRONT AND BACK VIEWS OF THE BERTRAND-OERLIKON RETORT CHARGER AND DISCHARGER.

upper portion of the woodwork of the machine, and the power is transmitted by endless screws rotating two spindles carrying chains. The platform is kept at any desired height by means of a counterpoise brake; and it can be lowered from one line of retorts to another in about 15 seconds. Horizontal motion is given to the machine by a third motor, with which a speed of about 65 feet per minute may be obtained.

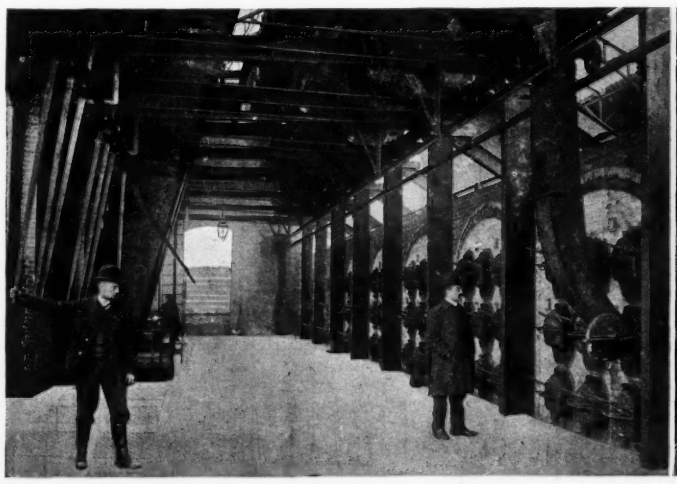
The originality of the system consists in the use of one and the same machine for effecting the two operations of charging and discharging retorts; thereby not only reducing considerably the cost of labour, but doing the work in the minimum of time. A bench of five settings of eleven 12-feet through retorts has been constructed to utilize the machine; and an average charge of 3¼ cwt. was reckoned upon—making one metric ton of coal carbonized per retort in 24 hours, or (say) 10 tons per setting. In view of the rapidity with which the operations are performed, it is estimated that eight similar settings could be served by one machine, and that consequently 80 tons of coal could be carbonized per day. For feeding the furnaces, a mixture of coal and breeze is used. An objection had been raised to the machine on the ground of the weight of the scoop in relation to the resistance of the retort. In reply to this, the author pointed out that, though a scoop when charged does not weigh less than 13¾ cwt., this weight is spread over the entire length of the retort, which is supported at distances of about 9 inches. Moreover, the retorts are made 2¾ inches thick.

A DERVAL SETTING OF RETORTS AT THE NANTERRE GAS-WORKS.

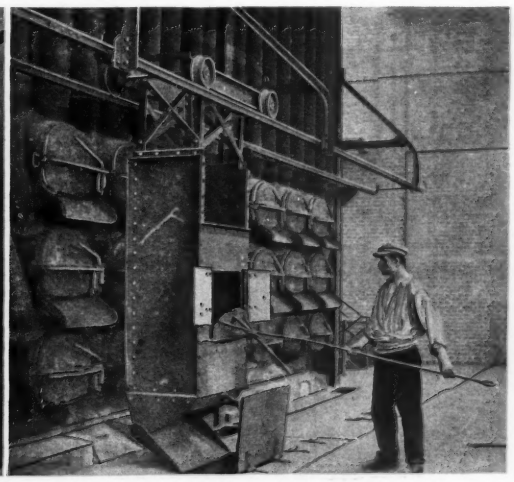
By P. PARSY.

[A Paper read before the Societe Technique last Tuesday.]

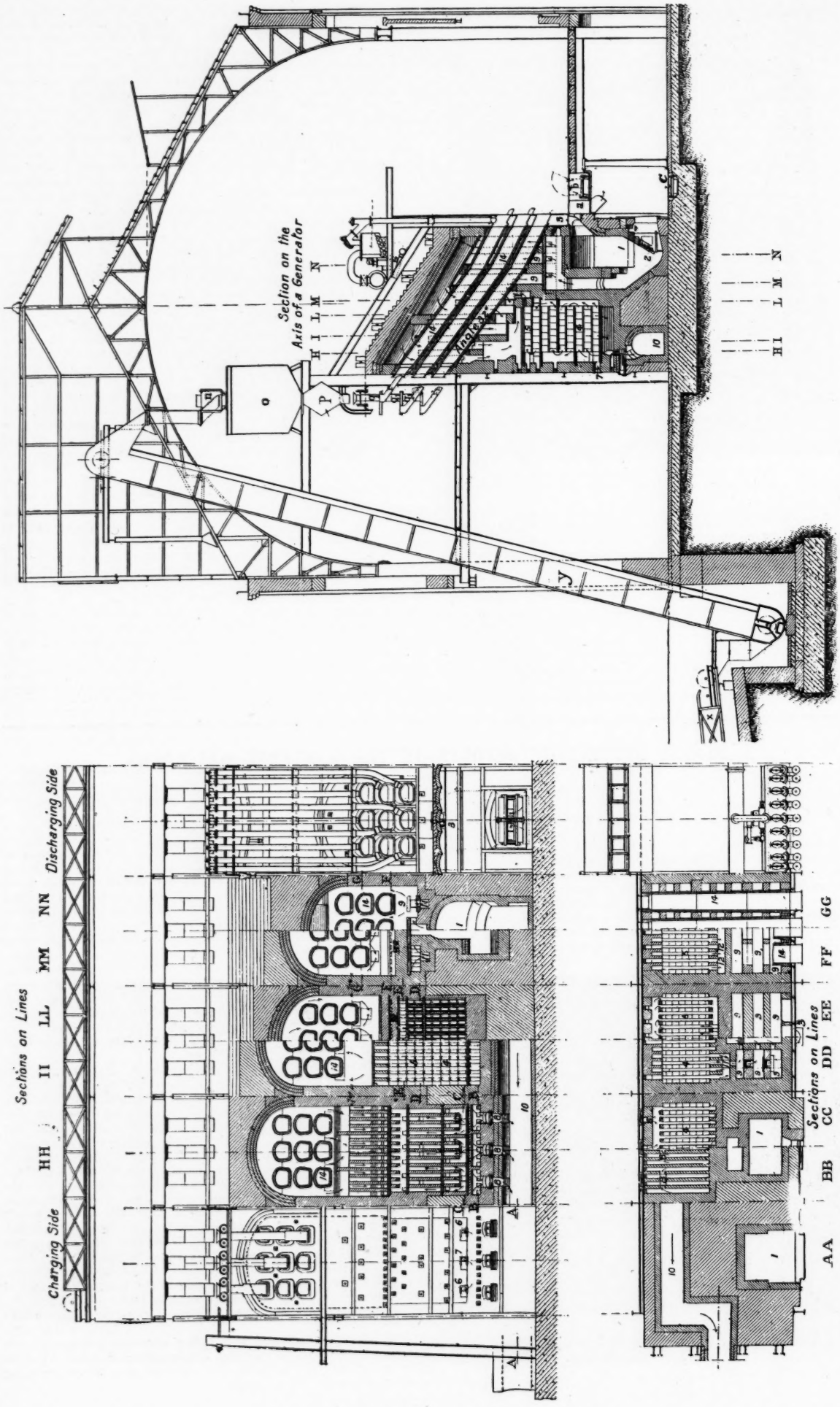
It is known that loss of heat by radiation is more marked in arches of inclined retorts through the increase of facing-surface, which results from the greater height of the bench. Moreover, these arches, which are generally built above the ground, are certainly more exposed to cooling by the outside air than those having their producers and regenerators in a cellar. For these reasons, it was desirable that the length of the retorts should be increased as much as possible, so as to raise the production of the arches. There also results from this higher carbonizing power of the arches economy in labour and cost, which it is unnecessary to dwell upon. The length of inclined retorts, which was at first 3·5 metres (11 ft. 6 in.) and then 4·5 metres (14 ft. 9 in.), has been carried in England to 6·1 metres (20 feet). This last dimension was that imposed by the Union des Gaz Company upon the Contractors for the retort-arches for their new gas-works at Nanterre.



THE RETORT-HOUSE CHARGING-FLOOR AT THE NANTERRE NEW GAS-WORKS.



THE DRAWING-STAGE WITH STOKER READY TO DRAW RETORT.


Section on the Axis of a Generator
H I L M N
H1 L M N
Sections on Lines
HH II LL MM NN
Charging Side
Discharging Side
AA BB CC DD EE FF GG

THE INCLINED RETORT INSTALLATION AT THE NANTERRE GAS-WORKS.

References to Diagrams of the Nanterre Gas-Works.

(1) Producer with barrier.
(2) Stepped fire-bars.
(3) Feeding-door of producer. A special shoot hung from an overhead carriage allows of directing the hot coke from the middle retorts either into the producer or into the coke conveyor.
(4) Lower part of the recuperator, in which the whole of the secondary air is heated.
(5) Upper part of the recuperator, where is finished the heating of the secondary air intended to complete at 12 the combustion of the gas.
(6) Air inlets for the first admission of hot secondary air at 9.
(7) Secondary air inlet for the second admission of hot air at 12. The bottom of the recuperator is divided into three parts—that in the middle serving for the passage of the air for the second combustion, which is highly heated in the top of the recuperator, before arriving at the openings 12.
(8) Waste-gas dampers serving each of the three parts into which the recuperator is divided.
(9) Principal combustion chambers. The first admission of hot secondary air is effected by two channels 11 placed under the lowest part of the side retorts.
(10) Waste-gas main flue.
(11) Hot air channels.
(12) Second admission of hot secondary air in order to complete the gas combustion.
(14) Inclined retorts, 20 feet long, at 32°. The inside section of these retorts is 23⅝ in. × 15 in. at the bottom, and 19¾ in. × 15 in. at the top, so as to facilitate the discharge of coke.

(*a*) Sheet hopper allowing, in case of need, the hot coke to fall into tip waggons running under the drawing-stage.
(*b*) Graham's hot-coke conveyor. The smoke and steam are sucked by a ventilator and exhausted outside of the house.
(*c*) Return of the endless grid of the conveyor.
(*n*) Pushplate conveyor feeding the coal hopper *o*.
(*p*) Measuring-chambers, Graham and Morton's system.
(q, q^1, q^{11}) Moveable shoots (Graham and Morton's system) for the charging of the retorts.
(*x*) Plate conveyor bringing the coal from the stores to the boot of the elevator *y*.

The building of the retort-house and bench of eight arches of nine inclined retorts each was confided to M. Derval, of Paris, by Messrs. Graham, Morton, and Co., of Leeds, who were charged with the general undertaking of this part of the works and with the mechanical plants for conveying coal and coke. The retort-house and bench are shown in the accompanying illustrations; fig. 1 being a front view and a plan of the bench, and fig. 2 a cross section. The coal is brought from the stores by conveyors discharging into an elevator, which lifts it to the top of the house, where it is thrown into a conveyor, which distributes it in a reservoir *o* which runs the whole length of the bench. Measuring-chambers *p* take the coal directly from this reservoir and allow it to fall, by means of moveable shoots q, q^1, q^{11} into the retort to be charged. Each vertical line of retorts has a measuring-chamber, the filling and emptying doors of which are worked by means of a single lever from the charging-floor level. The hot coke falls from the retorts into a quenching conveyor *b* placed at the level of the drawing-stage. This conveyor, which is on Messrs. Graham and Morton's system, is formed of a continuous steel grid running on rollers, and turning on drums at the ends of the bench. The return is down below the level of the producer floor. The quenching is done under a water-spray, and the excess of water passing through the grid runs into the bottom of the trough without swamping the coke. The steam and smoke are conveyed away by a ventilator placed outside the retort-house.

The bench is built in elevation above the ground. The furnace draught is effected by two chimneys outside at the ends of the retort-house. The producers and regenerators are placed altogether inside the bench, without any projection, which facilitates the buckstay strengthening and the placing of the coke-conveyor. Moreover, the producer on the drawing side can be charged directly with hot coke coming from the retort by means of a special three-way shoot (Graham's patent), hung from a moveable carriage, which can be run on two overhead rails fastened to the buckstay ironwork of the arches. This shoot has at its lower end a sheet lip, which enables the hot coke to be directed as desired either into the conveyor *b*, or into the producer or hopper *a*.

The heating of these arches is by double combustion of the gas, according to an arrangement patented by M. Derval, and already applied for some years to a bench of horizontal retorts in action at the Genoa Gas-Works. In this system, instead of following the ordinary run, which consists in the flames rising on each side of the middle retorts through their whole length, so as to go down again parallel along the arch and main piers, they run through the setting lengthwise, as shown by the arrows. On issuing from a first series of nostrils arranged in front of the setting, the flames rise vertically in encircling all the retorts, and are checked at the base by a thin wall placed across the middle of the arch. It is at this point that a second admission of hot air is supplied, with the object of completing the combustion of the gases not burnt. By this arrangement there need not, in fact, be admitted by the first nostrils all the air required for perfect combustion, which permits of lengthening the flame and of distributing the heat over the whole length of the setting. After this second burning, the flames resume once more the vertical run to the arch of the setting, and finally again descend into the recuperator, after circling the back ends of the retorts.

It will be understood that, by this system of double combustion, it is easy, by means of dampers, to obtain a perfect regulation of the setting, either by spreading the heat uniformly over the whole length of the retorts, or by increasing it at the front or the back according to the needs of carbonization. Another advantage obtained by the circulation of the flames longitudinally—and it applies equally to horizontal as to inclined retorts—is a perfect distribution of the heat over all the retorts of the arch. There is no longer to be noticed, as is usually the case, that some retorts are better heated than others. This is of great importance when it refers to mechanical chargings, which do not allow of varying the charges at every moment, if it is desired to obtain a good result from the apparatus, which ought to be regulated once for all.

The producer—which is of large size, because of the dimensions of the setting—is that ordinarily used by M. Derval. As regards the recuperator, it is modified a little in its general arrangement. It is still a continuous recuperator, built with the blocks of MM. Gaillard, Haillot, and Radot, without sockets or outside ribs; but the flames, instead of passing round the blocks, descend vertically inside, while the air to be heated circulates horizontally on the outside. A special partitioning of the recuperator allows the air to be directed into either the front nostrils or those at the back; and small regulating-valves permit of the exact allowance of air where it is required for good working of the setting.

The work was finished about December, 1903; and after drying for some weeks, the first beds were lighted up. There are now five beds out of the eight in the bench at work; and I am pleased to be able to say that the conditions of the specification have been fulfilled. Charges of 330 kilos. (6½ cwt.) per retort have been easily carbonized in six hours, and even exceeded in ordinary work. The guarantee of 13 kilos. of coke consumed per 100 kilos. of coal carbonized has also been achieved in the tests. By referring to the illustrations, the working of the setting in detail can be followed with the aid of the references.

Before concluding, I ought to make a few remarks on incidents which occurred during the start in working, and which were the object of a discussion at last year's congress of the Society at Toulon—I mean the slipping which takes place in the retorts during carbonization. This showed itself at Nanterre in a most serious and disquieting manner. The coal used came from Pas-de-Calais; it was Liévin coal, containing a large quantity of small. The greater the proportion of this, the more serious was the slipping. I wish to insist on the point that it had nothing to do with slipping during the charging, which was done in the normal way by the charging-machine. It was only after the closing of the retorts that the coal began to move towards the bottom. One could, moreover, become cognizant of this by opening the lids some minutes after the charge, when the phenomenon was quite visible.

The first remedy proposed was, naturally, wetting the coal. The results were satisfactory enough. With 4 or 5 per cent. of water, the slipping was checked; but it gave rise to trouble with the charging machinery and the measuring-chambers, from which the moistened coal did not fall properly. Regulating the charges became very difficult, if not impossible. In short, the results were only half satisfactory, when M. L'Homme, the Manager of the works, who, as will be understood, was much exercised on the situation, conceived the happy idea which solved the problem in the most ingenious and practical way. Having noticed that the coal slipped to the floor of the retort by sudden starts, as on an inclined plane being shaken (though the retorts were not subject to any vibration), he concluded that these jolts were produced in the mass by the tumultuous release of the gas in the initial stage of the distillation. These shocks became the more noticeable as the mass was more compact—that is to say, composed of smaller dust. In this state, the fluidity of the coal itself was greater; and as in inclined retorts the equilibrium is, so to speak, unstable, the result, under the influence of these repeated shocks, caused by the bubbling provoked by the liberation of the gases, is a movement which causes the charge to slip down.

It was reflection on this matter that led M. L'Homme to mix with the coal a body in small pieces, unsusceptible of distillation, with the view of dividing the mass and of assisting in liberating the gas. It is a process analogous to that used in laboratories when, in order to facilitate the ebullition of heavy liquids, like sulphuric acid, and to avoid the shocks which break the glass receptacles, there are introduced small pieces of pumice-stone, or bunches of platinum wire, which facilitate the formation and the release of the bubbles. The material thus incorporated with the coal by M. L'Homme was simply coke dust in the proportion of about 5 per cent., the presence of which could not injuriously affect the operation, if the quality of the coke was not altered. The results were marvellous. Not only did the charges no longer slip, but the coke itself, instead of being altered, came out from the retort perfectly compact and hard. The coke dust added to the coal was found to be incorporated in the mass with which it agglomerated. It is a real regeneration of this bye-product.

I am pleased to relate these experiences to our colleagues whom the matter may interest, and who, by repeating them, will be able to profit by them, and test a question which at present greatly occupies the whole gas industry, whose attention is now fixed on the improvements in the process of carbonization which are being brought forward from all sides.

REMOVING SUSPENDED PARTICLES FROM GASES.

At the Meeting of the Société Technique last week, a paper on the subject of the removal of solid and liquid suspended particles from gases, more particularly coal gas, was contributed by M. PHILIPPARD. The following are the principal portions of the paper.

Crude gas, as the lay visitor to a retort-house discovers, is not the colourless invisible gas of the chemistry book, but a dark-coloured fog. This fog the gas maker must dissipate in the course of purification. The first problem confronted in that process is the removal of the solid or liquid particles present in the gas as it leaves the retort—that is to say, the "condensation" of the gas. The present paper deals with this question. In other industries—for example, biscuit baking, the metallurgy of lead, silver, and other volatile metals—getting rid of the dust is an important problem. Whether this dust be solid or liquid, its removal from a given gas is based on the same principles; and it may be assumed that certain apparatus employed in the above-mentioned industries may be applied to the purification of coal gas. The general problem may be appropriately prefaced by a statement of certain experimental results in regard to coal gas and to naphthalene, in the course of which the writer may explain his conception of the nature of crude gas.

The physical purification of gas has to steer its way between two equally formidable dangers—excessive and insufficient cooling. The former throws down the benzene; the latter leaves the gas with too large a content of naphthalene—thus leading to the annoying stoppages caused by this substance. The tar also, as it is condensed, should be at once removed, in order that the benzene remaining in the gas may escape absorption in too great proportion. Yet, despite the observance of these precautions in the management of the gas before it reaches the Pelouze and Audouin condenser, continual trouble with naphthalene obstructions takes place in the town mains, necessitating the expense of remedies such as solution in anthracene oil saturated with benzene or keeping the naphthalene in the gaseous form by the addition of benzene, alcohol, &c., to the coal gas.

Two apparently contradictory methods are advised for the removal of naphthalene: (1) To cool the gas lower than the minimum temperature it will reach in the town mains; and (2) to pass the warm gas, on its way from the retorts to the exhausters, through chambers which are kept at a temperature higher than that of the course the gas pursued before reaching them. As both give good results, it must be supposed that the first is applicable in one case but not in another. The writer has had experience of both. At a certain gas-works, when the temperature of the vertical condenser was kept down by means of a water-sprinkler, innumerable deposits of naphthalene were reported in the town mains, but none in the works. They occurred as long as the watering was continued—viz., about a year—and reappeared each time the process was attempted afresh. Without sprinkling, the temperature of the gas leaving the condenser was 20° to 25° C. (68° to 77° Fahr.); with sprinkling, it fell to 14° C., or even to 12° C. (57° or 53·6° Fahr.). On the other hand, it was found that excellent results attended the maintenance of gas leaving the cooler at from 18° C. to 20° C. (64·4° to 68° Fahr.) in summer, by the use of a very little sprinkling, and from 26° C. to 28° C. (78·8° to 82·4° Fahr.) in winter; intermediate temperatures being adopted in the spring and autumn.

Bearing in mind the fact that the gas-mains, in their shallow trenches, were warmer in summer and colder in winter than the outlet of the condenser, there seems here to be a contradiction of the customary practice of cooling the gas below its subsequent minimum temperature, with the object of depositing all the naphthalene which it will throw down at this low temperature. There is, however, nothing paradoxical in the phenomenon; and an explanation is forthcoming in the theory of a "supersaturated" gas. Under certain conditions of temperature and pressure, a gas may contain more naphthalene than it can reasonably take up; just as, for example, a supersaturated solution of sodium sulphate can be preserved liquid in a sealed tube. But, as in the case of sodium sulphate, contact with a crystal of the mother substance (naphthalene) will cause the gas to deposit its additional charge, resulting in the well-known stoppages of mains.

On this theory was based an attempt to remove naphthalene while the gas remained in the works; care being taken that the plant really contained the substance. But, unfortunately, a gas has not the density of a liquid; and whereas the precipitation of sodium sulphate from a supersaturated solution takes place suddenly and completely, that of naphthalene from coal gas does so slowly, and only in the immediate neighbourhood of the crystals. And as it can be shown that the total time which elapses between the exit of the gas from the retorts and its distribution in the mains is frequently not more than five minutes, it is not surprising that the impurities held in solution by supersaturation should fail to deposit. Where cooling gives good results, it is because plenty of time is allowed for the gas to remain in the purifiers and holders. In those cases where it is found best to keep the gas at a higher temperature, it will be discovered that the gas traverses the apparatus more rapidly, or in a manner less favourable to the precipitation of the vaporized impurities. And where it is known that the rapidity with which the gas passes is the cause, it is advisable to raise the temperature of the condenser as the weather becomes colder, in order not to give the gas time, so to speak, to condense before it reaches the consumer. It is this consideration which has led to the adoption of the scale of temperatures mentioned above, and shown by practice to be the best in the particular case.

The principles of efficient purification may be summed up in the proper adjustment of the temperature at the outlet of the condenser; its variation according to the season; and the careful successive condensation of the tar.

Coming now to a consideration of the movements of solid or liquid particles in a stream of gas, a heavy particle, of dimension a and density d, falling in a resistant medium of density δ, is subject to three forces—viz., gravity $k'a^3d$, pressure $k''a^3\delta$, and friction $k'''a^2V^2$; and it is found, from calculation, that its velocity V is very soon—

$$V = k\sqrt{a\,(d-\delta)}$$

where k is a constant depending on the shape of the particle From this, it can be shown that the velocity is greater—

(1) As the particles are larger . . . . a greater.
(2) „ „ „ denser . . . . d „
(3) „ gas is lighter . . . . . δ less.

Also two tiny solid or liquid particles of different density will fall together if—

$$k_1\sqrt{a_1\,(d_1-\delta)} = k_2\sqrt{a_2\,(d_2-\delta)}$$

In the case of two drops of ammoniacal liquor and tar, both spherical, they will likewise fall together if the ratio of their diameters is—

$$\frac{a_1}{a_2} = \frac{d_2-\delta}{d_1-\delta}$$

or by simple approximation—

$$\frac{a_1}{a_2} = \frac{d_2}{d_1}$$

δ being practically negligible compared with d_1 and d_2.

These figures enable us to compare the velocities with which the most different materials deposit—for example, mill dust from the deposition chambers of a biscuit bakery; "lead smoke" (dust of metallic oxides); and "fog" of coal-gas tar collected at the entrance to the Pelouze and Audouin condenser by holding a piece of glass at the orifice of a cock. Examined under a magnifier of 200 diameters in the microscope, it is seen that the particles are all practically spherical, and that their diameters are—

a_1 (mill dust)	= 0·010 to 0·030 mm.;	mean 0·020
a_2 (lead smoke)	= 0·004 „ 0·008 mm.;	„ 0·006
a_3 (tar)	= 0·004 „ 0·015 mm.;	„ 0·010

The densities are about as follows :—

$$d_1 = 0{\cdot}8\ ;\ d_2 = 7\ ;\ d_3 = 1{\cdot}25$$

and hence the velocities of fall are—

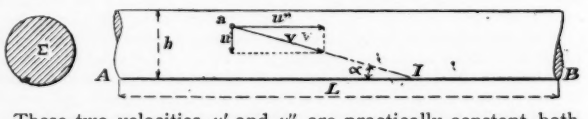
$$\left.\begin{aligned} V_1 &= k\ \sqrt{0{\cdot}020 \times (0{\cdot}8 - \delta_1)} \\ V_2 &= k\ \sqrt{0{\cdot}006 \times (7{\cdot}0 - \delta_2)} \\ V_3 &= k\ \sqrt{0{\cdot}010 \times (1{\cdot}25 - \delta_3)} \end{aligned}\right\} \text{ or neglecting } \delta_1, \delta_2, \text{and } \delta_3, \left\{\begin{aligned} &= k'\sqrt{16} = 4{\cdot}0\,k' \\ &= k'\sqrt{42} = 6{\cdot}5\,k' \\ &= k'\sqrt{12{\cdot}5} = 3{\cdot}5\,k' \end{aligned}\right.$$

Thus the particles are placed in the following order of increasing difficulty of condensation: (1) Lead smoke ($V_2 = 6{\cdot}5\,k'$); (2) mill dust ($V_1 = 4\,k'$), and (3) tar fog ($V_3 = 3{\cdot}5\,k'$). Three materials so different as these should exhibit striking differences when condensed in the same kind of apparatus and in this way the correctness or otherwise of theoretical results should be confirmed. Experiments in this direction are mentioned below.

Passing now to investigate the different types of condensers, we take first vertical and horizontal coolers. Suppose we have a straight horizontal tunnel, or tube, of height h and section Σ, traversed by a stream of gas moving at the rate u'' and laden with particles, (a), these particles, solid or liquid, will fall with a velocity given by the formula already mentioned—

$$u' = k\sqrt{a\,(d-\delta)}.$$

They have also a velocity straight forward—viz., that of the gas u''.



These two velocities, u' and u'', are practically constant, both numerically and in direction; and so the resultant velocity, V, follows a straight line—aI, in the figure. The angle of this resultant path is given by—

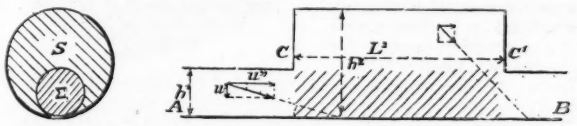
$$\tan.\ \alpha = \frac{u'}{u''}$$

The particle, on reaching I, adheres to the matter already condensed there. L being the length of the tube, it will be clear that if tan. α is greater than $h \div L$, the particles will be completely arrested before reaching B; if tan. α is equal to it, the dust will be condensed exactly in the length L; and if tan. α is less,

condensation will not be complete in L. Hence one is led to a similar apparatus in which tan. α is a maximum, h a minimum, and L a maximum. As tan. $\alpha = \frac{u'}{u''}$, and as u' is a constant for a certain kind of particle, and as $u'' = \frac{V}{\Sigma}$ (V being the volume of gas produced by the works, and here supposed to be constant for the sake of simplicity), it follows that the condition tan. α being a maximum is equivalent to Σ being a maximum. Hence we get to three conditions of proper condensation, which are not impossible in practice—

(1) Make Σ as large possible . . . a large section.
(2) Make h as small as possible . . of small height.
(3) Make L as large as possible . . of great length.

Hence it is clear that horizontal coolers which are made in this section ○ fulfil the three conditions just mentioned. Naturally the tube must be set with a slope, in order to allow the tar to flow away; but the slope should be opposed to the movement of the gas, not so much to avoid losing the advantage of the velocity u', as to promote a proper condensation of the tar. Nevertheless the values of V and h suffer; and this slope of the tube, indispensable in practice, is an unfortunate factor in condensation.



Expansion chambers are on the same lines as the preceding apparatus. Supposing a portion C C′ of our tube, of section Σ, is replaced by a chamber of larger section S, the original velocity u'' of the gas in A becomes $u'' \times \frac{\Sigma}{S}$ in C. Thus, if $S = 100\ \Sigma$, u'' becomes 1-100th of its previous value, and between C and C′ there is a veritable shower of the suspended particles. From the formula tan. $\alpha = \frac{h}{L}$, it can be seen to what length of horizontal tube a given chamber corresponds. The equivalent lengths of chamber and tube are inversely as their diameters. Thus, a chamber 20 metres (65 ft. 6 in.) in length is equivalent to a tube 200 metres (655 feet) in length, but of one-tenth the diameter. A simple calculation will show that the two appliances have the same surfaces, and require the same weight of metal for their contruction. The chamber, however, has the great advantage over the tube, that it occasions a quite insignificant loss of pressure. Both tube and chamber should have a section of the form shown above, and steps should be taken to prevent the gas following a middle course directly between the inlet and outlet. With this object, the gas is admitted by apertures in a pair of elliptical cheeks.

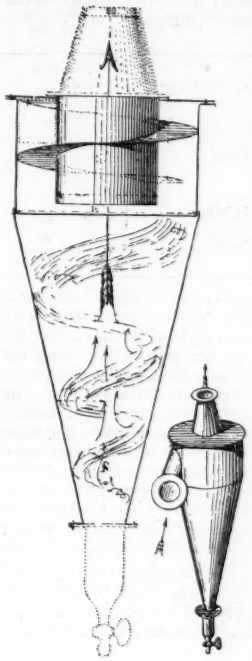
Vertical condensers are not amenable to the theoretical analysis adopted in the case of those of horizontal form. Their condensing capacities depend on the ballistic action of the particles in the gas; deposition taking place on the walls, especially at angles. As condensers, they are more efficient the greater the number of the tubes and the smaller their diameter; thus causing a corresponding loss of pressure.

In regard to the confirmation in practice of the comparisons instituted above between condensers, on theoretical grounds, some experiments made in a lead-works some years ago may be cited. There were only two horizontal flues, and so the dust-laden gas was treated in two other condensers of the kind used in biscuit baking—one a depositing chamber and the other similar to the "Cyclone" referred to below; both, worked in the manner indicated by theory, confirming, by the relative proportion of lead smoke and mill dust which they condensed, the purely mathematical conclusions already discussed. The results suggested the application of the "Cyclone" to the condensation of liquid suspended matter in coal gas; and the experiments made with that object will now be considered.* In this apparatus the gas and the suspended particles are acted upon by centrifugal force, which, in a section of radius r, is—

For gas . . . . . $F_1 = m_1 \omega^2 r$
,, suspended particles . . $F_2 = m_2 \omega^2 r$

where ω is the velocity of rotation projected on to the horizontal, and m_1 and m_2 the respective weights of two small equal volumes of gas and solid particle. As m_2 is large compared with m_1, $\sqrt{F_2}$ is also large compared with F_1; and so the dense particles are quickly separated from currents of light gas, attaching themselves to the walls of the apparatus, while these currents, being less affected by centrifugal force, leave the main stream and gain the outlet.

In designing a cyclone, the following is the method adopted: Arbitrary choice is made of the value of ω^2 R—say, 400—and the dimensions are found by trial. The conical portion is from 2 to $2\frac{1}{2}$ times the height of the cylindrical part; and the latter has a diameter $1\frac{1}{2}$ times its own height. The outlet is large in proportion to the other parts—about three-fifths the diameter of the cylindrical exterior shell, and about nine-tenths the height of the latter. The helix makes $1\frac{1}{3}$ or $1\frac{1}{2}$ turns, rising 15 to 20 centimetres in a metre—an amount sufficient to give the gaseous current a strongly helicoidal movement. The section included between the two plates of the helix is conveniently chosen as the section of the inlet. From this, and from the volume of gas to be dealt with, we obtain the velocity of the current, and from this ω^2 R; thus verifying the proper construction of the apparatus in the above proportions (which practice has shown to be satisfactory) to give ω^2 R as 400 for a certain current of gas. By way of example: A cyclone of 1 metre diameter, 2·5 metres high, and of rectangular section 0·20 × 0·24 metre, acts properly for mill dust and lead smoke when passing 425 litres per second.



Here ω = three revolutions per second, R = 0·50 centimetre, and ω^2 R = 9 × 50 = 450. This cyclone, although of such small size, is large enough to pass daily a volume of gas equal to 36,720 cubic metres (about $1\frac{1}{4}$ million cubic feet), which is the daily make of a large gas-works. Acting under these conditions, it does not lower the pressure of the gas more than from 1 to 2 mm. There is reason to attribute this to the conduits at the inlet and outlet more than to the apparatus itself, since two gauges, one placed before the inlet and the other after the outlet cone, distinctly show a slight expansion in the interior of the appliance. There is a wide range in choosing what is called the "characteristic" of the apparatus. We may fix on a number as high as 400 or as low as 200, or less than the latter in the case of large cyclones. For this reason, those with a variable consumption act in the same way as those in which it is constant.

In regard to the dimensions of cyclones, the larger ones—4 and 5 metres in height—are built of more slender proportions, as the suspended particles have then to traverse a thinner annular stratum of gas before reaching the walls of the apparatus. The condensed matter may accumulate on the walls to a thickness of several millimetres, afterwards collecting in a chamber at the foot of the cone. In the case of condensed liquid, the lower part of the cyclone can end in a cast-iron pipe forming a hydraulic seal with a pot underneath. Cyclones are constructed from thin iron plate; being strengthened with rings of thicker plate to give the necessary rigidity and to permit of their attachment to the supporting woodwork.

Passing now to the treatment of coal gas in cyclones, for the removal of suspended "tar fog," the gas examined with this object was collected at the inlet and returned to the outlet of the Pelouze and Audouin condenser. The difference in pressure between these two points was employed to work a cyclone connected with a meter, by means of a pipe of 30 mm. in diameter. Two pressure-gauges were connected to the cyclone. It was intended to run the apparatus with a "characteristic" of ω^2 R = 400—implying the passage of gas at the rate of 3·5 litres per second. But as a meter of sufficient size (150 lights) was not at hand, the gas was reduced to 1 litre per second, so that the characteristic became ω^2 R = 44. The experimental gas traversed the collectors, the foul main, and the condenser; and the time of the test was chosen so as to obtain gas while the retorts were being actively worked. The deposit formed when the gas was permitted to impinge on a clear piece of glass exhibited, under the microscope, the compound nature of its composition. Particles of tar, of ammoniacal liquor, and of water were visible; the latter enclosing crystals of naphthalene. At a less energetic period of the make, or when drier coal was used, the microscopic appearance was different; the large drops of ammoniacal liquor disappearing, and the deposit of fine aqueous and tarry particles being present in larger proportion. The remarkable enclosure of the naphthalene in the aqueous particles was noticeable in all cases.

The results of the trial, which extended over 24 hours, were as shown on the table, p. 878.

In the case of gas already treated by the usual works condenser, the total liquid collected per cubic metre amounted to about 2 c.c., and consisted of a small quantity of tar in the ammoniacal liquor. The latter was of the astonishing specific gravity of 14° to 15° Beaumé. On the completion of the tests, the cyclone was found to have its interior covered with naphthalene crystals—a fact which, taken in conjunction with the microscopic examination, shows the apparatus to be condensing the coarse aqueous particles from the gas as well as the extremely fine tarry and aqueous matter of the "tar fog."

* There is no need to give even the brief constructional particulars in M. Philippard's communication, as a detailed description of an apparatus on the same principle appeared in Dr. H. G. Colman's paper given in the "JOURNAL" last week (p. 760). The helical conduit at the inlet in M. Philippard's pattern serves the same purpose as the side inlet in the Tottenham apparatus.—ED. J.G.L.

Order of Tests.	Liquid Collected.		Specific Gravity of Ammoniacal Liquor.	Approximate Quantity of Gas Passed per Minute.
	Tar.	Ammoniacal Liquor.		
1	Traces	270 c.c.		80 litres
2	,,	90	14·6° Beaumé	50 ,,
3	,,	85		50 ,,
4	,,	80		50 ,,
5	,,	100		55 ,,
6	,,	166	14·5° ,,	55 ,,
7	,,	150		55 ,,
8	,,	165		55 ,,
9	,,	210		55 ,,
10	,,	162	15·0° ,,	55 ,,
11	,,	164		55 ,,
12	,,	120	14·0° ,,	55 ,,

In drawing conclusions as to the different types of condenser, regard must be paid to the fact that in actual practice the condition is the complex one of a gas containing both solid matter and easily condensable vapours—later, as the gas is cooled, giving rise to liquids. The further the condensation of the gas is carried, the lighter and more tenuous are these particles of deposited liquid; for it is a rule of distillation that the most volatile products are those of least density. For this reason, a cooling and condensing plant should not have all its elements of equal power. The last should be mechanically more efficient than those earlier in the series. Classifying the apparatus from this mechanical standpoint, we have: (1) Tubes and flues (horizontal) depending on the deposition of the suspended matter by gravity; (2) chamber condensers on the same principle; (3) vertical condensers, acting by friction on the walls and angles; (4) cyclones, working by centrifugal force and the impact of the suspended matter on the walls of the apparatus; and (5) condensers of the Pelouze and Audouin type, on which suspended matter collects by its normal impact on the walls.

In coming to a conclusion on the respective merits of these appliances, we may bear in mind their properties as stated in the earlier part of this paper, and also the two guiding rules in the purification of coal gas—viz., (1) that, to avoid naphthalene deposits, the gas, before entering the Pelouze and Audouin condenser, should be at a certain temperature which varies with different works; and (2) to retain the maximum lighting power, the condensed products should be quickly removed from the gas. In fulfilling these conditions, the balance of advantage lies very distinctly with the cyclone, which is also an efficient apparatus in regard to causing the minimum loss of pressure, in taking up little space, facilitating the removal of the tar, and thoroughly cooling and condensing the gas. Moreover, its behaviour suggests other practical uses for it. It can be used, at any subsequent stage of the treatment of the gas, to remove water and the naphthalene occluded in the latter; or, when water particles are absent from the gas, they can be introduced artificially. The cyclone can thus be made to collect ammonia—producing a concentrated liquor after the manner of a regular washer.

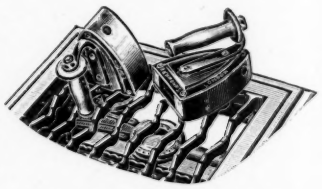
AN UP-TO-DATE COOKER.

No one can with propriety complain that the manufacturers of gas cooking stoves and appliances are slow to apply improvement that their own or other folks' experience suggests. At the same time, it has been a fairly long lane that has brought us to the present position; but if a modern cooker, with all its many conveniences, is set alongside one (say) of ten years or so ago, and examined part by part, the two things are found to be no more alike in the details than chalk is like cheese. Competition has, of course, been an incentive to healthy rivalry in improvement; and competition it is—the confession is made with the utmost frankness—which has been one of the reasons that has induced the Richmond Gas Stove and Meter Company, Limited, to make a new series of cookers of a greater capacity than the corresponding cookers of the "Model" series. If this was all that could be said about this new series of stoves, space would not be occupied in drawing attention to them; but it is not so. With the expansion in capacity there has been the incorporation of all the latest methods that the firm are cognizant of with the view of reducing the cost of maintenance. In other words, in the new series, they have had in view two things—to give a larger oven at a cost not above some of their present cookers having rather smaller ovens, and to bring down the expenses of maintenance to a minimum.

THE NEW COOKER.

In dealing first with the increased size, it is necessary to mention the stock numbers. The cookers are made in three sizes—Nos. 3075, 3100, and 3120; and the numbers corresponding to them in the "Model" series are 75, 100, and 120.

Now, as to the improvements. The top bars are made in three sections, and are simply dropped in position on the frame of the hot-plate, which frame is carried by curved supports from the sides, and not by bridges fixed on top, of the oven; and in this way the full expanse of the top under the boiling-burners and grill can be utilized without obstruction. The bars are made zig-zag, and bevelled off towards the bottom, so that the thickness of the bar where the flame first impinges is reduced as far as possible, and its stouter part is at the top where the cooking utensils are to be placed. Here, again, the tops are corrugated crosswise, so as to permit of the heat obtaining as much contact as possible with the vessels. One of the sections has a small rectangular opening provided in it just above the simmering-burner, for the internal heating of gas-irons; and the arrangement is such that the iron can be inclined, and get the full benefit of the flame playing on the bottom inside. In calling attention to this, the firm suggest that it would not be a bad idea if gas suppliers would include a couple of irons with their cookers in lending them out, as "ironing-day" would then be a sure contributor of a good addition to the consumption.



The top burners are all removable by simply lifting out. One movable carrier for the burners is stretched centrally across the hot-plate, and is supported, without fixing, in sunken seats at either end. The burners are maintained in position by slots in the carrier suitably fashioned for the purpose. Everything at the top being removable, a complete clearance can be made for cleaning the top plate. The tap-rail feeding the burners, like all other parts, is not a fixture, and yet it cannot be displaced unintentionally or accidentally. By lugs on the burner bar and locking slots in the side support, the connection is effected, and a union at the side connects up the gas supply. Among the other introductions is a double grill plate, the top fret of which is attached to a bottom fret; and this gives a double duty for the gas consumed. The burner can be used for grilling or boiling simultaneously, or the full effect of the flame can be obtained for boiling by the turn of a handle in a convenient position just under the top plate. In addition to the boiling and simmering burner, there is one of half-oval shape on the largest size cooker. This will be found very useful for large oval pots.

Returning to the oven, the fittings are of the usual character, excepting in connection with the enamel plates on the sides and doors. Contrary to the usual custom, these are fixed on entirely from the outside; so that, on the interior, there are no screwheads to serve as a lodgment for grease and dirt. Then at the top of the oven, there is a studded dome, towards the front of which are ventilating-holes. The effect is that all the waste heat passes by way of these holes into the chamber formed by the top, and the under dome, and then away to the flue-pipe at the back. The waste heat is in this manner utilized for maintaining the temperature in the oven and for warming the top plate. The flue-elbow is made oval, instead of round; and thus it collects a greater volume of waste heat, and gets it away quickly.

Another novelty is the method of closing the door. There is no latch; and the door is held in position by a simple but strong spring catch. On the door, where the latch is usually placed, there is a small projection; and on the frame is fixed the spring catch which engages with this projection. The advantages of this are that the door can be pulled open or pushed to without any danger of breaking the fastening; a tight joint is effected between the door and the oven; and in the event of an explosion inside the oven, there is no resistance. The spring is renewable by merely removing two screws. It is the ease of replacement of all parts that is the great feature of the cooker. The number of parts which make up the cooker are reduced to a minimum; and this the makers claim is an advantage to gas suppliers, who, as time goes on, need to stock for replacement. The castings have a good finish; and the general appearance and design of the cooker is something out of the ordinary.

The late Professor Williamson, whose death was announced in the "JOURNAL" for the 10th ult., left estate valued at £33,511.

Alderman Annan, of Wolverhampton, who died on the 13th of March last, as recorded in the "JOURNAL" at the time, left estate valued at £16,277 gross, including personalty of the net value of £10,945.

The President of the Institution of Civil Engineers (Sir William White, K.C.B.) held a reception of the members last Wednesday and Thursday evenings at the Hall of the Institution, Great George Street. About 1300 visitors were received each evening.

WORKING COSTS OF WATER-WORKS PUMPING-ENGINES.

By A. H. Meysey-Thompson and H. Lupton.

[Abstract of a Paper read before the British Association of Water-Works Engineers and of the Discussion thereon.]

The selection of a suitable type of pumping-engine is a problem which must have frequently come before most of the members of this Association. Often, of course, the particular conditions of the case decide the class of engine to be adopted, apart from the consideration of working costs; but still the amount of these costs must be an important factor. It occurred to the authors that the following examples, which, by the kindness of Mr. H. Ashton Hill, Past-President, and other engineers, they were able to place before the members, would be of interest. Following the example of Professor Unwin in his Howard Lectures on the "Development of Power," they reduced, for convenience of comparison, all costs to one common standard—viz., the cost of one pump-horse-power maintained day and night continuously for one year; this power being neither nominal nor indicated, but an actual 33,000 foot-pounds of work measured in water raised per minute throughout the year. They confined themselves to coal as the source of power, and chiefly to the steam-engine as the means of applying it, since the bulk of the heavy pumping in this country has been, and now is, done by steam-engines.

The number of types of engine at present in use is bewildering, and every type has its advocates. Although variations in the local conditions justify some diversity of type, two main lines of difference can be taken as covering water-works practice generally. The first of these is the mere question of size; the second is the relative positions of the engine and of the water to be pumped. These two conditions alone give four possible combinations—viz., surface pumps for small and large installations respectively, and well or borehole pumps, both small and large—and accordingly four main types of pumping-engine will be considered, although, of course, further variation in practice arises both from the competition of inventors and the varying tastes of engineers.

Surface Pumps (*Small Power*).—Dealing with the four main combinations referred to, the first applies where the water is within suction distance of the pump while the power required is small. Up to 20-horse power, this work is chiefly done by rotative or direct-acting steam-pumps. The coal consumption is high, amounting to as much as 10 lbs. per horse power in water lifted; while labour costs are also considerable in proportion to the work done. Such circumstances, however, lend themselves most favourably to the use of electricity (if such be available), either from a central station, or, as in the case of large county asylums, from private stations in use for other purposes.

As regards the working costs of small installations, the authors regret that, owing to the comparative indifference with which these small plants are regarded, they have no reliable figures; but they consider that a fair estimate for a steam plant of this class, generating (say) 21-horse power for eight hours a day, or 7-horse power continuously throughout the year, and employing one man at 35s. a week, would be: Labour £13, and coal (taking the consumption at 10 lbs. per horse-power-hour, equivalent to a duty of rather more than 20 millions to cover banking fires and all losses, and supposing the cost to be as low as 10s. per ton), £19 11s. per continuous horse power per year. Oil and stores would amount to another £3, and repairs (say) to a further £3; making a total cost of £38 11s.

Turning to the relative cost of pumping by electricity, since no stoker would be needed, we may put the labour at (say) 2s. per day to cover general supervision, oiling, &c. At this rate, plant giving 7 continuous horse power would involve labour charges amounting to £5 4s. Instead of fuel, there would be electric power, which, at 1d. per unit and 75 per cent. efficiency, would cost £36 6s. Oil, stores, and repairs would be small with a plant of this kind—say, together, £5. Thus the total cost of one continuous horse power in water lifted night and day for the year would amount to £46 10s. This, it will be noticed, is higher than that with an independent steam plant; but, on the other hand, the greater convenience of the plant, and the total absence of coal dust, smoke, and ashes, may be considered as compensating for this to a great extent. As an example taken from practice, the actual cost of pumping at an asylum will be interesting. Here the average continuous horse power in water lifted was only 4·12 (year ending March, 1902). Electricity was supplied at 1½d. per unit, and the water, owing to the necessity of softening, was pumped twice over—first from a well (lift 120 feet), and afterwards into a water-tower (lift 96 feet). Under these somewhat unfavourable conditions, though the cost per 1000 gallons delivered was not excessive—being 3·38d., including repairs—the actual cost per continuous horse power per year amounted to £113 3s.

In many cases, small geared pumps may be, and frequently are, driven by gas-engines. It will therefore be interesting to consider the relative costs in such cases. Assuming the consumption of gas at 24 cubic feet per horse power per hour, and the efficiency and other items the same as in the case of electrical plant, it will be found that the price of gas to produce a result equivalent to that obtained with electricity at 1d. per unit and a similar cost of pumping—viz., £46 10s. per continuous horse power for the year—would be 2s. 7d. per 1000 cubic feet.

Well or Borehole Pumps (*Small Power*).—Where the water is not within suction distance of the pump, it is, of course, necessary to draw from a deep well or borehole—an alteration of conditions which largely modifies the type of plant required. In a well it is possible to use electricity to operate a three-throw pump. But a plant of this kind involves considerable cost, not only in making the well, but in supplying the motor, gearing, frame, and three sets of pump-rods and "trees." If, however, steam is in any way available, it is a much simpler and more efficient plan to use a small beam-engine, having the cylinder at one end of the beam and the pump at the other. With a plant of this kind, a single pump with a diameter as small as 4 inches and a stroke of 3 feet can conveniently be used. A considerable number of these engines are in use; but the authors do not possess any accurate information with regard to annual costs. It is, however, safe to assume that such an engine would be worked, taking the cost of coal as 10s. per ton, at an average duty of 25 millions—equivalent to (say) 9 lbs. of coal per horse power (in water lifted) per hour. On this basis, the cost per continuous horse power per year of a plant of the same size as that taken in the previous case, including labour, stores, and repairs, would work out at £36 12s.

Surface Pumps (*Large Power*).—Compared with the conditions previously dealt with, even a very moderate increase in the amount of work to be done will greatly favour the use of an independent steam plant. For example, a small cross-compound engine of less than 30 actual horse-power (water lifted) supplied for the Hull Corporation, having cylinders 9 inches and 18 inches in diameter respectively, and 18-inch stroke, working condensing with 120 lbs. of steam pressure, gave on trial a consumption of 26·1 lbs. of steam (measured from the condenser) per pump-horse-power per hour—equivalent, at an assumed evaporation of 10 lbs. of water per pound of coal, to a duty of 85 million gallons. This very satisfactory result was due, first, to the fact that the pump-plungers were directly attached to the piston-rods, so that there was no loss through gearing, and a mechanical efficiency of 86·8 per cent. was obtained; secondly, to the fact that the pump was fitted with large water passages and small light valves, and was run at the comparatively high speed of 59½ revolutions per minute. In this connection, it is interesting to note that at 40 revolutions per minute the pump consumed 30·6 lbs. of steam per horse power (water lifted) per hour; being equivalent, on the same basis as before, to a 72 million duty.

The question of duty comes into special prominence where considerable quantities of water are to be lifted, as for the supply of large towns; and in this respect there has been a very marked advance in the results obtained during recent years. But as the working cost from day to day is the vital point of interest to the water-works engineer, the authors have given in the following table (p. 880) figures supplied by Mr. Hewson, of Leeds, and Mr. Parry, of Liverpool, showing the actual cost of pumping for a complete year in these towns.

At the Headingley pumping-station of the Leeds Corporation there are two triple-expansion vertical engines, each of about 160-horse power. Besides these there are two old beam-engines, not required for the ordinary supply, but retained as a stand-by, and occasionally worked to see that they are in order. During the year ending March, 1902 (the last year of which the complete figures were available at the time of writing), the total quantity of water pumped was 775,060,000 gallons; the average lift being 205 feet, after deducting a small head which there is on the suction. These figures give a continuous night and day horse power in water lifted of 91½. To pump by means of electricity at the same cost as at the Headingley station, taking the efficiency of the motor and pumps at 75 per cent., and supposing that half the labour bill belongs exclusively to the steam plant, current would have to be supplied at 0·32d., or (say) ¼d. per unit. The figures which Mr. Parry has given are the costs of pumping during the year 1902 with a similar triple expansion engine to the one above referred to. The total quantity of water pumped was 1,345,702,000 gallons, the average lift being 93 feet. These figures give a continuous night and day horse power in water lifted throughout the year of 72·15. If electricity were used for pumping, a similar calculation to that applied to the Leeds case shows that, to produce an equivalent working cost, the price of current would have to be 0·227d., or (say) 0·23d. per unit.

Well or Borehole Pumps (*Large Power*).—In pumping plant for drawing water from wells or boreholes, in which the horse power to be exerted is considerable, there has, in recent years, been a considerable advance made as regards economy. As an example, the case may be quoted of a compound differential direct-acting condensing engine, built for Mr. Isaac Carr, of Widnes, where a duty of 109 millions (measured out of the condenser, and calculated on the basis of a 10 lbs. evaporation) was obtained. With a similar engine, built for Mr. Ashton Hill, the Engineer to the South Staffordshire Water-Works Company, a duty, calculated on the same basis, of 107 millions was obtained; and more recently an engine of the same type, but triple-expansion, also built for Mr. Hill, gave a duty of 122 millions. In considering these results, it should be observed that in each case the water was pumped twice over—first to the surface, and then by a second pump into the mains.

Turning to the actual annual costs of well-engines, the authors are enabled, through the kindness of Mr. Hill, Mr. Carr, and Mr. Henry Davey (of Westminster), to give in the table figures which they think will be of considerable interest to the members. Those

—	Mr. Ashton Hill's.			Mr. I. Carr's.	Mr. Hewson's.	Mr. Parry's.
Name	Hinksford.	Shenstone.	Ashwood.	Netherley.	Headingley.	Aubrey Street.
Type	Vertical compound rotative.	Horizontal compound differential direct-acting.	Horizontal compound differential direct-acting.	Horizontal compound differential direct-acting.	Triple-expansion vertical rotative.	Triple-expansion vertical rotative.
Total height of lift	485 feet	563 feet	483 feet	370 feet	205 feet	93 feet
Average continuous night and day horse power in water lifted throughout the year	144	125	178	125	91½	72
Boiler pressure per square inch	100 lbs.	60 lbs.	60 lbs.	70 lbs.	130 lbs.	140 lbs.
Average duty in millions, including all losses as in the cases before quoted	51½	43½	47½	46½	65	69
Price of coal delivered in yard, coal used being local slack	8s. 5d. per ton	7s. 5d. per ton.	8s. 1d. per ton.	9s. 3d. per ton.	9s. 8d. per ton.	8s. 1d. per ton.
Actual costs per continuous night and day horse power in water lifted for the year—						
Coal	£7 1 0	£7 7 0	£7 7 3½	£8 12 6	£6 9 0	£5 2 4
Wages, including stokers and all labour	3 8 3	3 14 8	2 15 2	2 19 11	10 3 8	6 5 2
Stores and oil	1 2 1	0 13 8	0 11 6	0 7 2	2 5 8	0 12 5
Repairs	0 15 2	nil	0 10 6	1 10 1	0 15 6	3 13 4
		£11 15 4				
Add repairs as at Ashwood		0 10 6				
Total	£12 16 6	£12 5 10	£11 4 5½	£13 9 8	£19 13 10	£15 13 3
Equivalent price at which electricity would have to be supplied	0·24d.	0·25d.	0·24d.	0·28d.	0·32d.	0·227d.

Remarks.—In the case of Liverpool, the £3 13s. 4d. charged for repairs to the engine includes other plant. In the cases of Mr. Hill and Mr. Carr. the water is pumped in two stages; in those of Mr. Hewson and Mr. Parry, once only.

supplied by Mr. Hill for three of his stations were in each case for a continuous run of six months, and the authors reduced them to the year's average to facilitate comparison with the others. At two of these stations, the engines are differential and direct-acting; while at the third the engine is rotative. It will be noticed that while this engine is rather more economical in coal, the saving is counterbalanced by the reduced cost of oil and stores in the case of each of the direct-acting engines. The labour bill was almost identical at each of the stations; the variations per horse power being due to the difference in the number of hours. All the engines are of modern design, having been built within the last four or five years, and all alike are steam-jacketed; so that they are in all respects very fairly comparable.

To emphasize the contrast between the costs of pumping with modern engines and those which are obtained with out-of-date plant, the authors give figures relating to some old pumping-engines which have been retained in use for Birmingham, in view of the construction of the gravitation works now in progress. These figures will illustrate the doubtful economy of retaining old plant merely because it continues capable of pumping water. At the Whitacre pumping-station there are four main engines, two of them compounds and two low-pressure Cornish engines, and three steam-pumps. The cost of a continuous horse power for a year is £19 13s. 10d. At the Plants Brook pumping-station there is one compound and one Cornish engine, both working at 45 lbs. boiler pressure; and the costs per horse power are £20 1s. 4d. At the Aston Wells, where there are two old Cornish engines working at only 35 lbs. boiler pressure, the figure is £28 7s. 3d. It is of interest to compare these results with those obtained at Ashwood and Netherley, where, with modern engines, the same unit of power is provided at a cost of from £10 14s. to £13 10s.

Discussion.

Mr. Dewhurst (Chelmsford) said in his district they had no steam plant. They confined themselves to oil and gas. There was considerable cost in connection with a steam-engine. There was the cost of conveying the coal, or whatever other material was used, to the place where they wanted it; and then they had to remove the waste material. He had advised his Council to adopt ordinary gas. As regards oil, they had to decide whether they should use the refined product or the crude kind. He had one engine on which he used crude oil for driving and refined oil for the lamp; but in using the former there was great liability of chokage, and there was the question of cleaning. Petroleum at 6d. a gallon would pay them better. As an Association they had to deal with all kinds of water-works; and while triple-expansion engines might be best for large works, they were out of the question for small ones. If each member of the Association would give his experience of the cost of his particular plant, the information could be tabulated, and it would be most valuable.

Mr. J. H. Crowther (Wallasey) expressed regret that the paper was simply a record of facts. It did not give any idea as to which was the better type of engine. He did not think justice had been done to gas plant. Where they could get electricity at a small charge, they would also be able to get gas at less cost than had been stated.

Mr. C. E. Jones (Leyton) remarked that the steam-engine was done for, and should be relegated to curiosity museums. Gaseous fuel was taking the place of solid fuel; and the engine of the future would be the gas-engine. Electricity had been mentioned; but this simply transmitted the power already there. The electric light companies were becoming so convinced of the economy of the gas-engine that one had concluded a contract with the local gas company for ten years for a supply of gas for the purpose of generating electricity for lighting. This, he thought, was a very significant fact.

Mr. H. Preston (Grantham) said he had had an oil-engine of 42-horse power working for two years on crude oil. Practically no time had been lost in cleaning, and there had been no choking. It was also equal in working capabilities to an engine run with refined oil, while the cost was very much less. He bought his oil at 2¼d. per gallon. He was able to pump 32,000 gallons of water per hour; so that the engine with which he was working was not a small one.

The President (Mr. F. J. Bancroft) remarked that the paper was of great practical value.

Mr. Meysey-Thompson, in replying, said his communication originally grew out of some facts which he and his coadjutor had brought together for themselves. They were constantly being asked which was the best type of engine, and what it would cost. Manufacturers always welcomed criticisms of engines from people who used them. At the same time, he claimed, on behalf of the manufacturer, that he should be considered a little. Very often they were not consulted until after the engine-house was built; and then they had to design an engine that would fit it. This made it very hard for them to standardize. Personally, he did not see how it was practicable to make a small installation as cheap as a large one. It would be absurd, for instance, to make a 10 or 15 horse power engine triple-expansion; the cost would be enormous. The question had been raised as to whether, when they had hydraulic power, it was better to use it electrically. It seemed to him that when they had hydraulic power they should use it. The hydraulic question, however, could well form the subject for a paper in itself. It had been said that beam-engines could not be fixed so cheaply as the other types. He had his own opinion on this, and it was that they could. All a beam-engine required was a hard floor. It was self-contained, and they could "dump it down" on a hard floor, and there was an end of it. He agreed that the first cost was important; yet, on the other hand, it was rather a delicate matter for a manufacturer to bring forward. Mr. Carr had given him figures showing that the cost of the 125-horse power engine he erected was £10,450; so that a direct-acting ball-pump was not a very expensive one to put down. He quite agreed that steam was dying out, and that the gas-engine was the motor of the future; but they wanted to know what was the cheapest engine to adopt at the present time. Gas had not shown itself to be the most economical fuel in competition with steam; so that he thought people might put down steam-engines with a good conscience.

Mr. Lupton also briefly replied; remarking that if information could be obtained from the different pumping-stations, as had been suggested, it would be most valuable, as they could then find out what class of engine gave the best results in actual work. If the Association would take up this matter, it would be of great service.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Mr. H. E. Jones and the Nanterre Gas-Works Installation.

SIR,—In your issue of June 14 (in which is reported the discussion that followed Mr. Bell's paper on the De Brouwer stoking machinery at Derby), I read some remarks made by the President of the Institution of Gas Engineers, that I have no difficulty in identifying as referring to the retorts at the Nanterre Gas-Works, near Paris, inspected by Mr. Jones about three weeks ago; neither have I the slightest difficulty in distinguishing the insidious suggestion against my Company that the words employed contain; nor in detecting the head of the "ancient hatchet," used by those old-time gas engineers who considered themselves as belonging to an altogether superior order of beings to the engineer-contractors, against whom they dealt their blows.

My object in noticing Mr. Jones's parti-coloured statements is this: My Company have liberally advertised themselves as the contractors responsible for the complete installation of the inclined retorts and the coal and coke handling plants at the new French Gas-Works; and, such being the case, it is only fair that they should set matters in their right light, by bringing clearly before unprejudiced readers of the "JOURNAL" a fact altogether suppressed by Mr. Jones. To accomplish this, it is only necessary to refer to the terms of the contracts between my Company and the Continental Union Gas Company. The contracts were as follows:—

Contract A.—A complete contract for coal-handling plant for coal-stores.

Contract B.—Complete retort-house and roof; all ironwork; coal conveying and elevating machinery; eight Derval's inclined retort settings (sub-contract).

Contract C.—Complete contract for the hot and cold coke handling and storage plant.

Contract D.—Complete contract for gravity bucket conveyor for handling oxide in purifier-house.

Now the point which Mr. Jones omitted to mention was one of paramount importance to the Contractors; and it is that classed under Contract B.—*i.e.*, that the Gas Company stipulated for "Derval's" system of furnaces, which were designed, constructed, and equipped by M. Derval, 23, Rue Chauchat, Paris; he accepting entire responsibility for the construction and working of the furnaces built by him to his own designs.

My Company naturally regard this as a crucial point, and the more particularly as they have instituted legal proceedings against the Continental Union Gas Company. In the interests of my Company, and as their Managing-Director, I have not the slightest hesitation in courting a thorough and searching inquiry into the matter; and meantime it is my determination to challenge and refute any statements made against my Company that in my estimation may be false and damaging.

Many leading contractors are with me in deploring what we consider to be Mr. H. E. Jones's abuse of the privileges afforded him by the occupation of the presidential chair on the occasion referred to by the "JOURNAL." To strike honourably and from the shoulder, is one thing; to employ as a weapon insidious suggestion, is quite another. With the traditional Englishman, I prefer the former.

MAURICE GRAHAM,
for GRAHAM, MORTON, AND CO., LIMITED.

Leeds, June 15, 1904.

Mr. Jones's Address—The Object of Gas Engineers' Gatherings.

SIR,—I wish to correct one word in your report of my address to the Institution of Gas Engineers. On page 636, line 48 of col. 2, the word "more" should be "less"—regrettably inverting the sense. It was quite my own fault, as it was not corrected on the copy I read from, though it had been on the rough copy.* I am glad to find that, throughout the whole of the report of the long proceedings, the greatest accuracy prevails.

I cannot close this letter without protesting against the statement in an article just to hand from the "Colliery Guardian," that "the gathering of the Gas Engineers [would be] converted to the utilitarian purposes of *rendezvous*, at which the gas engineer is free to make his unholy compact with the coal man, the meter man, and the oil man." Surely, the sacrifices made by the two Institutions for fusion on the common ground of excluding absolutely the trading element from the membership, the meetings, and the excursions, cannot be ignored, even by the most benighted contributor of this ill-advised journal. My successor must forthwith consider some steps to the public refutation of this broad infamous reflection.

You have called my address something of a "sermon;" and its *motive*—viz., the uplifting of the status of the gas engineer and the inspiration of a high ideal of professional rectitude—was apparent enough. But never did I dream that such charges as these could be formulated against our craft by any respectable newspaper. If the divisions between engineer and contractor are not yet defined with sufficient boldness, then we must persevere to make them so; and a year in office has taught me that in the Council and members of our Institution we have the men with courage and truth to do it. We must go on.

H. E. JONES.

Marden Ash, Ongar, Essex, June 18, 1904.

* This was enclosed in the letter.—ED. J.G.L.

The Earl's Court Gas Exhibition.

SIR,—Will you kindly grant me a little space in which to draw attention to one object of the International Gas Exhibition, which should, I think, prove advantageous to exhibitors as well as interesting to the general public, and also instructive to the gas engineering profession?

There are doubtless in this country, and also abroad, many who have originated useful inventions, for which, owing to lack of opportunity, they have so far failed to secure recognition. For such persons, the Exhibition will provide an excellent opportunity for introducing their devices to those likely to secure their adoption.

With this object in view, the Committee will be glad to receive and to consider, before Sept. 1, 1904, applications for space (to be allotted free, subject to certain conditions) in which drawings, or preferably models, descriptive of such inventions as I have alluded to may be exhibited.

I also wish to add that it is the intention of the Committee to arrange for competitions, in connection with which prizes will be awarded to the designers of the most artistic and serviceable fittings for the lighting of private houses, churches, public halls, railway stations, &c., for the best and most tasteful forms of lamp-columns and lanterns for public lighting, and for other devices likely to popularize the use of gas.

May I express a hope that the Editors of Continental and American journals will convey to their readers an invitation to take advantage of the facilities to which I have alluded?

J. W. HELPS,
Croydon, June 18, 1904. Hon. Sec. of the Advisory Committee.

Conversion of Coke Dust and Breeze into Large Coke.

SIR,—Mr. Carpenter's letter to you of the 13th inst. is by no means convincing on the point at issue.

This is not the first time that important advances have been declared to be failures in the Metropolitan works which have proved to be unqualified successes in the Provinces—notably carburetted water gas and inclined retorts.

Probably Mr. Carpenter did not himself supervise the thorough mixing of the 5 per cent. of coke dust and breeze with the coal, which I have found necessary to ensure success.

The matter is, however, so simply proved by every individual manager, that controversy is quite needless on such a matter.

Edinburgh, June 16, 1904. W. R. HERRING.

SIR,—It has been our practice here for some years to buy coal dross from local coal merchants and carbonize same mixed with good caking coal—using as much as one-third slack. It has often occurred that coke breeze and other less marketable material has also been added—amounting to 10 per cent. of the whole; and although the slack used is a non-caking variety, the coke resulting from the mixture is of very good quality.

No increased make of gas from the addition of breeze has been noted—this not being the object aimed at.

With the right sort of coal, and judicious mixing, I see no difficulty in converting breeze or even less promising materials into large coke.

Ballina, June 16, 1904. T. J. REID.

Mixing Breeze with Coal to Prevent Coals Creeping.

SIR,—In your leading remarks on this matter, you mention that the suggestion emanated from Mr. Leech. This is not so; as M. L'Homme, the Engineer of the Nanterre Gas-Works, was in this particular instance the originator. I happened to be there at the time, and know the facts of the case.

Much trouble arose at Nanterre owing to the "slipping" or "creeping" of the coal in the retorts; and for many weeks this nuisance rendered M. L'Homme's life miserable. He then hit upon the idea of adding 5 per cent. of breeze to mitigate the evil; and he asserts that it has had the desired effect.

Both abroad and in England, many cases of coals "creeping" in inclined retorts have been brought to my notice; and although I have questioned several engineers, no two seem to be agreed as to the reason. I would, therefore, respectfully put it to the profession that this is a matter which requires special and careful investigation; and the writer will be specially grateful to anyone who will enlighten him (and fellow-sufferers) as to the real cause of the phenomenon.

F. D. MARSHALL.
Queen Anne's Mansions, S.W., June 14, 1904.

[This question was referred to in the latter part of a paper read before the Société Technique du Gaz en France last week, by M. Parsy, a translation of which appears elsewhere to-day, p. 873.—ED. J.G.L.]

The Report of the Departmental Committee on the Testing of London Gas.

SIR,—I think it will possibly be expressing a general feeling when I state that a keen sense of disappointment was experienced by me on perusal of the long-expected report on the Testing of London Gas. The report naturally takes the form of recommendations; and, although the high scientific attainments of the Committee are beyond criticism or dispute, the conclusions will probably have to pass through a severe ordeal of criticism before there is any change in legislative administration.

There are several classes of people who will regard the report with (to use your own expression) "mingled feelings." The gas company supplying 14-candle gas will be justly irritated and agrieved by the system of testing for illuminating power advocated by the Committee, and will certainly not consider concessions in other directions as an equivalent for a radical alteration on what is probably the most important of the whole questions which have been under consideration. The London County Council will no doubt be dissatisfied with the recommendations as to the abrogation of the sulphur clauses; the

limitation of the stringency of the sulphuretted hydrogen test; and last, but not least, the expression of opinion that peripatetic photometry and Sunday testing are practically unnecessary. The scientific photometrist (a class with whom I hope I can claim intimate relationship) will regard the recommendations of the Committee as to the method of testing gas—"all qualities of gas"—with the most unmitigated astonishment.

After all the work that has been done, and the statistics that have been published with regard to the necessary modifications of testing in order to develop the (as far as may be possible) true illuminating value of different grades of gas, it is difficult to believe that such a method of testing should be seriously recommended by a Committee of scientific experts.

Placing economic considerations for the present on one side, the method of testing advocated is absolutely unscientific. The development of light from gas depends largely on conditions of combustion, and mainly on the ratio between volume of gas and proportion of air. The development of heat (apart from light) may also be said to be subject to the same conditions. The methods of producing the desired effects are, however, different. The bunsen flame is supplied with air by admixture of air with the gas prior to combustion, supplemented by the air which reaches the flame externally. In the development of light, the air supply is exterior, but depends on many complicated questions, all of which are devoted in the best burners to the main issue of maximum light development. With a sufficiently tall chimney and a gas correspondingly deficient in illuminating hydrocarbons, it might be possible to produce a bunsen effect—viz., the maximum of heat, and the minimum of light—without the direct admixture of the gas with the air prior to combustion. This is the direction to which the recommendations of the Committee tend—viz., combustion of low quality gas with the air supply required for gas of higher quality. The method of combustion advocated, I regard as a process intermediate between the best means of developing the value of gas for heating and for lighting purposes. It is not photometry; it is not calorimetry; but it is a bastard product with no pretensions to a decent paternity. It is neither "fish, flesh, fowl, nor good red herring."

The adoption of one burner as a standard for testing, I have advocated—viz., the Sugg "London" argand—with the modification, however, of adapting the conditions of combustion to the quality of the gas. The prescription already in use for the 14-candle gas supplied by the South Metropolitan and Commercial Gas Companies—viz., burning the gas to a 16-candle flame—is a fair compromise between the light attainable from a rigid 5 feet consumption and that possible on burning the gas at a higher rate.

Turning to the other recommendations of the Committee, I am glad to note one as to a change in the method of testing, for sulphuretted hydrogen, which would afford a necessary relief from the more stringent process now in vogue. The method advocated is also clearly defined.

The recommendation as to the abrogation of the sulphur clauses has, in my opinion, much in its favour; but, unless the Gas Companies are going to discontinue the use of lime—or, in other words, to cease purifying their gas from carbon dioxide—the nuisance from the production of foul spent lime will still be more or less in evidence.

I am also glad to note the transfer of decision in most ordinary cases of deficiencies in questions of quality of gas supply to the hands of the Chief Gas Examiner, in place of the hearing of the case in an ordinary Police Court, where the Gas Company's explanations had to be placed before a more or less untechnical Magistrate, and the case sliced in between the latest burglary and the most recent criminal assault.

The recommendations as to subjective tests to be made on the gas, with regard to the value of the illuminating power in some special flat-flame burner, the record of sulphur, the calorimetric value, &c.—all unofficial—are purely a matter of scientific research, and should not, in my opinion, be mixed up in any way with official testing.

There are many other questions for consideration on the subject-matter of the report; but I do not wish at present to trespass any further on your space.

June 16, 1904. H. LEICESTER GREVILLE, F.I.C., F.C.S., &c.

Mr. Cranfield's Address.

SIR,—The "Juniors" have certainly a doughty champion in Mr. Cranfield; and the lucid manner in which he has stated their case should be productive of good, not only to the juniors, but to the gas industry generally.

Although he divides the making of gas under three heads—commercial, engineering, and chemical—each is merged into the remaining two to such an extent that the junior cannot reasonably hope to attain to a high-water mark of success unless he thoroughly cultivates all three. Take carbonizing alone, for example. How can one hope to attain the fullest measure of commercial success without the aid of a fair knowledge of chemistry and mechanics?

The juniors of to-day will be the seniors of to-morrow; and I cannot see how any engineer having the welfare of the industry at heart can hesitate about providing anything that will help them in their thirst for technical improvement. Even yet, the "close corporation" is practised on many works; articled pupils only having the requisite opportunities of acquiring all-round knowledge of gas-works routine. I never could see why the race for honours should be confined to the privileged rather than the clever.

Works of 20 millions or more should have a well-equipped chemical laboratory, free (under reasonable regulations) for the use of any young man on the works of sufficient ability to use it without abuse. This implies, of course, a previously attained knowledge of chemistry up to (say) the end of the second course South Kensington syllabus, organic and inorganic. Central laboratories on the lines laid down by Mr. Cranfield would give professional guidance which can only be rendered of full benefit by the personal application of the student in the works laboratory. This would not by any means place the "mere employee" on the same footing as the articled pupil; for the latter would still have that personal tuition and guidance from his chief which the payment of a premium is supposed to ensure.

I am not conversant with the practice of engineers in this respect throughout the kingdom, but believe that most gas engineers in this part of Yorkshire are anxious to give the juniors every encouragement, and a fair field.

Longwood, June 14, 1904. J. H. BREARLEY.

SIR,—Having been from home attending the annual meeting of the Institution of Gas Engineers, I have only just seen your issue of the 7th inst., and read the able and thoughtful address delivered to the Yorkshire Junior Gas Association by their President (Mr. Cranfield), and your "Editorial Note" thereon.

No doubt, very beneficial results would accrue if Mr. Cranfield's suggestions, with which I am in complete sympathy, could be carried out; but they depend, as pointed out in your article, upon the provision of the necessary funds. Your statement that "past experience shows that, excepting in comparatively few cases, the purse-strings of gas undertakings are rarely loosened for purposes that are for the general good," is doubtless true; but I think this is, to some extent, our own fault. The splendid response to Sir George Livesey's appeal to the companies and corporations owning gas-works to find the sinews of war for his highly successful contest with the Welsbach Company over the mantle question, shows that, if properly approached, there are both the will and the power to respond; and I think if an appeal were to be made officially to all the proprietors of gas undertakings in the kingdom by the Institution of Gas Engineers, backed up by such men as our ex-President and Sir George Livesey, the response would not be disappointing.

There are many directions just now in which funds are required in order to maintain the prosperity of the gas industry. I shall, I think, be betraying no secrets when I say that at the last meeting of the Council of the Institution, two or three proposals of vital interest were laid before us. For each suggestion, funds were necessary; and the members of the Council found themselves on the horns of a dilemma. We all felt on the one hand that we could not reject these proposals without harm resulting to our industry; and yet we did not feel that it was right to use the funds of the Institution for such purposes—consisting only, as they do, practically, of the yearly subscriptions of the members, which barely suffice to pay the necessary expenses of administration. Proprietors of gas undertakings would reap all the benefit; and they surely cannot expect their officers to pay out of their own pockets for such services.

We have a grand International Gas Exhibition coming on at Earl's Court in the autumn. This, if properly carried out, will be of enormous benefit to our industry; but it cannot be expected that exhibitors will do their best unless they can derive some benefit from the exhibition. The provision of medals, and the carrying out of the exhibition so as to show what gas can do, if directed by the trained experts of the whole profession, cannot be carried out without funds; and surely the companies and corporations owning gas-works are the proper authorities to provide these funds (which to them will be a most remunerative investment), and not the managers of gas-works whose pockets are none too deep. These latter can only be expected to give of their best in brains and time, which I am sure they will all do ungrudgingly.

In other directions, too, funds are urgently required. Undesirable precedents are being continually created by Parliamentary Committees, which will trammel our industry in the future, but which cannot be contested for want of funds. A case of this kind came within my own experience. A Commons Committee before whom my Company appeared a short time ago, created a most dangerous and undesirable precedent; but my Directors could not see their way to carry their opposition to the House of Lords, as the matter was not worth the expense to them. We tried to get the Gas Companies' Protection Association to take the matter up; but they had no funds for the purpose. So the precedent was allowed to be established, and will doubtless prove a stumbling-block to many others in the future. And so one could go on multiplying instances.

It seems to me that what is wanted at this juncture is a well-organized attempt to arouse gas owning companies and corporations to a sense of their duty in this respect; and, if properly undertaken, I feel quite confident the effort would not be without adequate result.

In the Council of the Institution, when broadened through affiliation by representatives from the District Associations all over the country, the gas undertakings would have the best guarantee that their funds would be wisely and carefully administered on those objects only which were necessary to the well-being of the gas industry.

Wakefield, June 14, 1904. H. TOWNSEND.

SIR,—I have carefully read over Mr. Cranfield's address to the Yorkshire Junior Association, which appeared in the "JOURNAL" last week; and I also perused the editorial comments thereon. I am favourably impressed with Mr. Cranfield's suggestion, and think that every endeavour should be made to get the idea formulated and put into practical shape. Thereafter a scheme should be promoted to ensure the necessary capital for the foundation and equipment of a laboratory on the lines laid down, and, further, to obtain the annual financial support requisite for carrying on the work.

I may say that I shall give particular emphasis to the subject when the time comes round for addressing the members of the Scottish Junior Gas Association (Eastern District), the first annual meeting of which will be held early in October. In the meantime, I have an idea that the local gas corporations and companies might be sounded as to how far such a plan would meet with their co-operation.

Edinburgh, June 14. ALEXANDER MASTERTON.

Slot-Meters.

SIR,—With reference to the letter from Sir George Livesey published in your issue for April 19, p. 163, and Mr. Colson's paper read at the Institution of Gas Engineers, I should like to state some of the results obtained in this town during the past few years relative to the same,

as, unfortunately, I had not an opportunity of attending the meetings of the Institution of Gas Engineers recently held in London.

The income each year at Huddersfield from slot-meters has been as follows:—

Year ending March, 1897 . .	£133	Year ending March, 1901 .	£8,133
,, ,, 1898 . .	1,021	,, ,, 1902 .	10,905
,, ,, 1899 . .	3,308	,, ,, 1903 .	12,510
,, ,, 1900 . .	6,123	,, ,, 1904 .	15,513

The quantity of gas at first supplied was 25 cubic feet for 1d.; but in April, 1898, it was increased to 30 cubic feet, which equals 2s. 9½d. per 1000 cubic feet, with a further concession of a gas-cooker fixed free. The ordinary lighting price is 2s 9d.; and for stoves, engines, &c., 2s. 3d., both subject to 5 per cent. discount.

At the present time, there are 10,128 slot consumers out of a total of 23,728 consumers, or about 43 per cent. Of the slot consumers, some 15 per cent. were originally consumers through ordinary meters—a charge of 2s. 6d. being made for the change.

The number of slot-cookers in use is 8171. The gas sold through these slot-meters last year was about 112 million feet, or nearly 20 per cent. of the total gas supplied for all purposes; so that, approximately, as the result of the slot system, there has been a net gain of 95 million cubic feet of gas to the department upon the year.

Internal gas-fittings are not supplied by the department beyond the fixing of the gas meter and stove. All service-pipes are supplied free of charge within 30 feet of the roadway.

In the case of Huddersfield, the concluding paragraph in Sir George Livesey's interesting letter is abundantly corroborated—to the effect that the slot-meter has "been the means of causing by far the greatest development in the use of gas that the industry has ever experienced during the whole course of its eventful and beneficent history."

Huddersfield, June 15, 1904. EDWARD A. HARMAN.

Gas and Electric Lighting Expenses in Massachusetts.

SIR,—From the totals given in the report of the Massachusetts Gas and Electric Light Commissioners for the year 1903, the following comparative analysis of expenses is made up in terms of cost in cents per dollar of income for the average of all electric light stations as against the average of all gas-works in the State:—

Electric Light Stations.	Cents.	*Gas-Works.*	Cents.
Coal, oil, waste, &c. . . .	23·5	Supplies (less residuals) . .	25·0
Wages at station . . .	9·2	Wages at works	9·7
Repairs ,, . . .	4·2	Repairs ,, ...	4·6
Clerks and collectors . .	3·8	Clerks and collectors . .	3·6
Repairs to lines, &c. . . .	8·0	Repairs to mains, &c. . .	4·6
Free renewals lamps . . .	2·5	,, stoves in use . .	0·7
General salaries	6·5	General salaries	4·6
Taxes	6·8	Taxes	6·2
Insurance	1·7	Insurance	0·9
Legal expenses	1·0	Legal expenses	0·7
Bad debts	0·1	Bad debts	0·1
Claims	0·1	Claims	1·0
Other expenses	4·4	Other expenses	3·0
Total	71·8	Total	64·7

Municipal plants, whether gas or electric, are not included in the above synopsis, which, while being very general in its character, may, it is thought, be of interest for purposes of comparison.

New York, May 21, 1904. STUDENT.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following further progress has been made with Bills:—

Bills read a second time: Brymbo Water Bill, Baker Street and Waterloo Railway Bill, Lytham Improvement Bill, North-Western Electricity and Power-Gas Bill, Skipton Water and Improvement Bill, Local Government Provisional Orders (Gas) Bill.

HOUSE OF COMMONS.

The following further progress has been made with Bills:—

Bills brought from the Lords, read the first time, and referred to the Examiners: Derwent Valley Water Board Bill, Newcastle and Gateshead Water Bill.

Lords Bills reported: Matlock and District Gas Bill, Preston Corporation Water Bill, Shipley Urban District Council Bill. Ticehurst and District Water and Gas Bill.

Lords Bills read the third time and passed: Chesterfield Gas and Water Board Bill, New River Company Bill.

GLEANINGS FROM THE COMMITTEE ROOMS.

THERE has been during the past week a little break in the monotony of the Committee rooms for those concerned in gas matters. The Matlock and District Gas Company have scored a signal success against the rabid onslaught of the District Council of Matlock Bath. It will be noticed that the Company have got their power-gas clause through. They took the advice recently tendered in the "JOURNAL," and brought up local evidence to show the existence of a demand for such gas. The South Shields Gas Company have had their prepayment meter clause amended to conform with the Chippenham clause in respect of the extra price of 1s. Gas companies, it is seen, are continuing to avail themselves of all opportunities for attempting to get the Bermondsey clause applied in Bills and Orders relating to electricity supply. This is a good sign. It shows a determination not to slacken the agitation until the goal is finally reached. The Oakengates, Dawley, and District Joint Water Board Bill has gone through Committee; but the powers sought by the promoters have been considerably curtailed. The Barnet District Gas and Water Company are to again meet very strenuous opposition over their new water scheme. We wish them a happy issue. The electrolysis clause question has got into a tight corner, and is specially referred to in the leaderettes in another part of the "JOURNAL."

The Prepayment Meter Clauses. Advantage has been taken of the amendment of the prepayment meter clauses (upon which information was given in the "Gleanings" and "Editorial Notes" on May 17 last) by the South Shields Gas Company. In the early stages of the progress of their Bill, this Company had the prepayment clauses inserted, not of their own motion, but by the authorities at Westminster, and with the tenpenny limit. But with the changes made in the Chippenham and Yorktown cases, the Company decided not to remain with smaller powers and privileges in this regard than those two Companies if they could avoid it. Therefore, when the Bill came before Lord Balfour of Burleigh last Tuesday, the Company asked that the prepayment meter clause might be omitted; it being pleaded by Mr. Cripps that the clause would involve the Company in loss. This the Engineer (Mr. T. H. Duxbury) showed would be the case. The Company supplied 30 million cubic feet of gas last year by slot meters; and the extra cost per 1000 cubic feet represented 1s. 2½d. The difference between this and the 10d. which the Company would be entitled to charge was 4½d., or more than £500 per annum. Lord Balfour was afraid that if the clause were expunged, the Company would withdraw what was a considerable convenience to the poorer classes in the town, or would put such a charge upon them as would be prohibitive. His Lordship need entertain no fear in this regard, as the prepayment meter system is found to be so beneficial to gas suppliers that they are not likely to do anything but cherish its growth. All they desire is that no injustice shall be done as between the prepayment and the ordinary consumers. It was pointed out by Mr. Cripps that he had not liked to suggest the amendment of the clause by the insertion of a higher figure than 1s., which was the Chippenham figure. Lord Balfour, however, allowed an amendment of the clause; and 1s. now stands in the Bill as representing the utmost the Company are to be permitted to charge in the case of prepayment meters over and above the ordinary consumers.

Litigious Matlock Bath. There are some folks who are never happy unless they are engaged in contention of some sort, even when their case is of a beggarly order, and has not a shred of right to support it. The Matlock Bath District Council have proved, by deed and word, both by past record and their insensate action in connection with the Matlock and District Gas Company's Bill, their fitness for being placed in that inglorious category. They opposed the Bill in the House of Lords, praying for things which were unreasonable to the last degree; and their prayer fell on deaf ears. In a short comment on the case and issue in the "Gleanings" for March 22 last, it was remarked that it would be a strange thing if the Council came to Westminster again this session on a similar errand. But the strange thing has happened. The salutary lesson administered by the Lords has had no effect. The Council had a vehement desire for another passage of arms with the Gas Company. They have again been to Westminster with the forces marshalled by the Chairman of the Council (Mr. J. E. Lawton); they have spent an amount of the ratepayers' money in the Commons which, from all appearances, will exceed what they expended in the Lords; and the result is they have again been covered with ignominy. If those ratepayers who were coaxed into consenting to this second fight at Westminster against the desire of some of the more influential—in social position and in common sense—of the ratepayers, do not now smart under this second rebuff when they are called upon to foot the parliamentary account, and do not call upon their representatives for an explanation of their misguiding advice, it will be equally as strange as the foolhardiness of the Council. The Chairman's pleasant and off-handed deftness in disposing of awkward matters cannot always succeed. The story is worth running over, viewed in the light of this second attack on the Company. It will show the hollowness of the Council's case, and may have some good future effect.

Objects of the Bill, and the Attitude of the Authorities. The Matlock and District Gas Company are seeking power to convert and consolidate their capital, to make a considerable addition to it, and to obtain permission to issue the stock to consumers and employees, in accordance with the well-conceived policy of some of our foremost gas administrators. In addition (to complete the principal objects of the Bill), the Company ask authority to manufacture and supply power gas, to use their funds in an application for an Electric Lighting Order, and to extend their area of supply to the parishes of Rowsley and Winster. Another proposal was a reduction of the standard illuminating power from 15 to 14 candles. But against this the Local Authorities generally were strongly antagonistic; and so, prior to appearing before the Committee, the Company agreed to let the candle power remain as at present. It speaks volumes for the Company's record and relations with the Local Authorities when we say that, though there are five in the existing area, and two more are concerned in the proposed extension, with all but one the Company were able to arrange terms, and secure their goodwill on behalf of the Bill. Dr. Moxon (the Chairman), Mr. Robert Hall (the Secretary), and Mr. T. Brown (the Engineer) must be congratulated on this comfortable condition of things. The fly in the honey was the litigious Matlock Bath Council. The Council have their own gas undertaking; but the Matlock and District Gas Company have within the area governed by the Council a small district of supply, of which the Council desired to obtain possession. The Council have a somewhat larger area of supply than the Company;

but the bulk of it is merely agricultural land—it is not larger in the number of consumers, but it is in quantity of consumption. The Council contended that they ought to have the whole of the gas supply in the urban area; but there are good and sufficient reasons, from the point of view of the consumers of the Company's gas, why they should not. Still the Company were not averse to a little bargaining; and they stated their willingness to give way on this point provided the Council would reciprocate by giving up the area of supply lying outside their urban area, and within the urban area of the Matlock District Council. This is the third time the coveted area has been fought over in Parliament; but the Company have taken a consistent attitude in the matter, and one which appears to be absolutely just. On the other hand, the Council, it should be stated, were willing to buy out the Company's interest in the area in question. The consumption of gas there only amounts to 2 per cent. of the Company's total; and the Council made the most of this. They tried to show the Committee that this was such an insignificant matter that the Company could give it up, and not feel it. But it will be readily apparent to all disinterested persons that a great principle was involved here, which might have had, if the Council had realized their ambition, ulterior consequences of a serious nature for the Company. Under the Act, which the Company have now all but secured, they will be supplying seven different Local Authorities; and if one had been allowed to purchase a piece of the Company's area, a precedent of an insidious and dangerous character would have been created. It is easy to see that the remaining authorities might one after the other have come along asking for similar powers; and amputation might have gone on until the Company would have lost a great deal of what was of value to them. Although many attempts have been made, Parliament has ever refused to dismember a Company's area on the application of a local authority. There is another aspect of the case which should be brought prominently before the ratepayers of Matlock Bath; and it is that, the consumption of gas in the coveted area being so small, the profit must be likewise small. This being so, is the area worth the price that would have had to be paid for it, *plus* the large expenditure that has been incurred in trying to obtain it in face of the objection Parliament has shown to all attempts at compulsory severance? The purchase, regarded in this light, would have been most improvident.

The Company and Power Gas—The Result.

As the Council found there would be some difficulty in persuading the Committee to adopt their views in respect of this small area, they opposed the Bill on almost all points, and especially in regard to the power-gas clause. The ground was again cut from under the feet of the Council by the Company offering to specifically exclude the Council's area from the operation of the clause. To say the least, with the other Local Authorities desiring the Company to persevere with the power-gas clause, it was somewhat impertinent for the Matlock Bath Council to seek to interfere with those districts in connection with this matter, especially in view of the Company's offer. So far as we remember, there has not been a case in which a power-gas clause has been granted to a gas company where there has been opposition; but this case is essentially different from such precedent—seeing that all the local authorities, excepting Matlock Bath, were in favour of it. It was certainly a case in which the majority had a right to prevail. Capital was sought to be made out of a pronouncement of Sir John Brunner, in his capacity as Chairman of the Committee who considered the Rickmansworth Gas Bill some time since. He said: "We shall not pass the preamble with regard to power gas; and I think it my duty to say that I entirely agree with Mr. Woodall upon that subject. I think it is entirely contrary to public policy that the right to make power gas should be allowed in isolated cases up and down the country everywhere. Just as it is adjudged to be improper to allow little spots to be taken out of the country for the supply of electrical power, so we think it is improper in the case of power gas." The point may as well be made now as at any other time, that Sir John's views on the question of the supply of power gas cannot be altogether unprejudiced, seeing that the names of Brunner and Mond are so very closely and honourably linked together. His *obiter dictum* on this subject will not rule Parliament; and, though it was made great use of in this instance, it has not ruled Sir Henry Aubrey-Fletcher's Committee—their decision on the matter conforming with the Company's concession that they should not supply power gas within the area of the Matlock Bath District Council without their previous consent in writing. The case absorbed the attention of the Committee over two days; and then it came to rather a sensational end. The Council were distinctly challenged to put their witnesses in the chair; but they declined—contenting themselves with the speech of their leading Counsel (Mr. Wedderburn, K.C.), whose *copia verborum* was expected to work the needful trick; but it did not. The tactics of the opposition, however, deprived Mr. Balfour Browne, K.C., of his right to a reply for the Company. The Committee considered their decision in private; and, on recalling the parties, they announced the preamble proved, but instructed that a clause should be brought up stating how much capital it was proposed to use for power-gas purposes (giving as many particulars as possible), and ordered the insertion of a clause exempting from the operation of the power-gas clause the small area within the Matlock Bath Council's district. The Company have obtained a very comprehensive Bill; and the fact that it has been carried through in both Houses without compulsory eliminations of any kind is a matter upon which they may pride themselves. The Matlock Bath Council have secured nothing, excepting the slight proviso attached to the power-gas clause. The question for the ratepayers is, Is this proviso worth the cost of two parliamentary contests? Matlock Bath is only a small place. A penny rate represents the modest sum of £40. It has been stated that the cost of the opposition in the Lords amounted to £203, which involves a rate of 7d. in the pound. We shall expect from the way in which the case has been fought in the Commons that the expenses will far exceed the total in the Lords. The Engineer consulted by the Company was Mr. E. H. Stevenson; and by the Council Mr. Corbet Woodall. Counsel for the promoters were Mr. Balfour Browne, K.C, and Mr. Courthope Munroe. In the Upper House, Mr. Hutchinson and Mr. Clement Edwards were for the District Council. Last Monday and Tuesday, Mr. Wedderburn, K.C., was Mr. Hutchinson's leader. We believe too, though not speaking authoritatively on this point, that the Solicitor and Parliamentary Agents for the Council were not the same as those who were engaged in the Lords. If true, why? They have not gained for the Council anything more than the professional gentlemen they replaced. A little examination of all these matters will assist those interested to come to a conclusion as to whether the costs incurred in the Lords have been exceeded in the Commons. For our own part, we have not the slightest doubt on the subject.

The Charge for Power Gas.

A few minutes were occupied on Thursday morning in considering the clauses which the Company brought up at the request of the Committee in respect of the power-gas supply. In the first place, it was seen that £15,000 had been allocated by the promoters (in consultation with Mr. Stevenson) from the additional capital for the purposes of the power-gas supply. Another interesting feature of the clauses is that they specify the charges to be made for the power gas. For gas of a calorific value of 125 British thermal units, 6d. per 1000 cubic feet may be charged, and 1d. for every additional 25 candles. A clause acceptable to the Committee was also brought up excluding the portion of Matlock Bath and Scarthin Nick which is within the area of the Company from the operation of the power-gas clause, unless the previous consent of the Council to supply is obtained. Right to the last, the Council did their utmost to harass the Company. A notice of opposition to the clauses was given by them; and this put the Company to the expense of being again represented by Counsel. Then, when clauses were brought up, the Council were only represented by their Parliamentary Agent. The Matlock Bath Council have nothing to be proud of in connection with their appearances before Parliamentary Committees this session. We shall be looking for trouble when the ratepayers learn the truth of these things.

The Bermondsey Clause.

There are three Electric Lighting Orders Confirmation Bills and the Doncaster Corporation Bill now before the Duke of Northumberland's Committee; and in all cases the question of the introduction of the Bermondsey clause is under hard discussion. The Committee were to commence work on Thursday morning; but they failed to obtain a quorum at the appointed hour. By twelve o'clock they had succeeded; and work went along merrily—the proceedings being greatly enlivened by one noble Lord. Next day all the parties fared considerably worse. Four of their Lordships were present; but the loquacious peer of the day preceding was not. The work of the Committee could not commence, and adjournment had to be made from time to time; and at two o'clock the Duke of Northumberland announced that the proceedings would have to be postponed until Monday. It is a very serious matter to know that the action of one member can stop public work in this way, put a room-full of professional men and promoters and opponents to such inconvenience as this, and cause the day's expenses of the parties to be wasted. It is, however, something to be thankful for that such a thing as not being able to get a quorum is a rare occurrence. However, the Chairman announced that by Monday another peer would be there to serve on the Committee. Those engaged on the Bills were as sincerely sorry for their Lordships, as their Lordships were for those whose time was being fruitlessly and expensively spent in the corridors. For the insertion of the Bermondsey clause in these Orders, there are several Gas Companies petitioning; and the matter is going to be vigorously fought out. Mr. Balfour Browne, K.C., is opposing the insertion of the clause; and, in the first case—the Maidenhead—Mr. A. M. Paddon was engaged last Thursday in working up a strong case for the Gas Company. (The usual report will be published next week.) Before the Committee finally adjourned on Friday, both promoters and opponents agreed to take the decision of the four members after the cases in connection with the other Bills have been heard. An unusual point has turned up in connection with the Doncaster Bill. There is no opposition to the gas part; and it will be merely the duty of the Gas Engineer (Mr. R. Watson) to formally prove the preamble. But in the electricity section, the Corporation are seeking to enlarge the area so as to make it coterminous with the gas area, including the outside districts. This part of the Bill is being opposed by the South Yorkshire Electric Power Company, who have authority to supply in bulk in the area outside the borough. They are therefore opposing the Bill, in order to obtain the insertion of the Bermondsey clause as against the Corporation. This is a queer condition of things. The Company have an extensive area in South Yorkshire; but at present they have only a generating station at Thornhill, some 30 miles from Doncaster. The Company fear that, if the Corporation have power to supply electricity to outside Councils, as they themselves get towards Doncaster, they will meet with what they term "unfair competition." That is the very point the Gas Companies have been trying to inculcate on our Legislators ever since the Bermondsey clause was originated.

Huddersfield and Longwood Gas Company.

A peculiar position has been created by a little premature action. The Longwood Gas Company petitioned against the Huddersfield Corporation Bill for the purpose of getting the Bermondsey clause inserted. Before the Bill could come before the Duke of Northumberland's Committee, the parties agreed on the insertion of the clause—one condition, of course, being that the petition of the Gas Company should be withdrawn. This was done; and yesterday week the Bill was removed from the consideration of the above Committee to that of the Unopposed Committee of the Lords. The parties were then in a quandary as to how they were to get the clause into the Bill. They sought the aid on Friday of the Duke of Northumberland; both Mr. Balfour Browne and Mr. Claude Baggallay appealing to him to help them out of the muddle. The Committee, however, had no jurisdiction; and the Chairman refused to have anything to do with the matter. He referred the parties to the Lord Chairman for his advice. What will happen has yet to be seen. Of course, the insertion of the clause has been agreed subject to the approval of Parliament and the Board of Trade. Another difficulty will be to get the sanction of the Board; but it is quite possible they may not have the same objection to an agreed clause of the Bermondsey stamp as they have to the compulsory insertion of such a clause. We shall see—that is, if the

parties can get over the primary difficulty of having the clause placed in the Bill.

A Joint Water Board. The Earl of Dartrey's Committee last Tuesday finished the consideration of the Oakengates, Dawley, and District Joint Water Board Bill, which proposed to constitute and incorporate a Joint Water Board composed of representatives of urban and rural district councils in Shropshire. The limits of supply proposed were the urban district of Oakengates, Dawley, a portion of Hadley, and a part of the parish of Wellington rural. The scheme limned out in the Bill contemplates the construction of two new wells and pumping-stations at Newport and Oakengates, with certain other works at Wellington and Wenlock. The Board desired to borrow £60,000 for sixty years. The Wolverhampton Corporation, the Wellington (Salop) District Council, and the Duke of Sutherland were the active opponents; but the Corporation were satisfied early in the proceedings. Later on, too, the Duke of Sutherland and the promoters entered into a satisfactory arrangement. The district has suffered greatly from the want of a proper water supply. Hadley and the Wellington rural district are within the limits of supply of the Wellington District Council; and though they have not provided, and have not in a recent attempt been successful in providing, a supply for this particular part of their district, the Council objected to parting with their powers to the Joint Board. The subject was argued up and down in all its trivial details for two whole sittings and part of a third. In the result, the Committee found that the preamble was not proved so far as it related to Hadley and the Wellington rural parishes. There was something approaching consternation among the promoters on the decision being announced; and the Chairman, in his remarks, recognized that there was just the possibility that they would not care to proceed with the measure. At first the promoters had visions of the Bill being useless; but their chief opponents—the Wellington District Council—saved the situation by engaging to take water in bulk from the Board for the supply of Hadley and the Wellington rural district. Of course, this was not what was contemplated by the original Bill; and the supply in bulk will not be such a profitable matter for the Water Board as the direct supply of the consumers. However, they are, under these circumstances, proceeding with the measure; but the loan is to be repaid in fifty years—not sixty.

HOUSE OF COMMONS COMMITTEE.

Monday, June 13.

(*Before Sir* HENRY AUBREY-FLETCHER, *Mr.* J. H. DUNCAN, *Mr.* JOHN HAMMOND, and *Mr.* PHILIP FOSTER.)

MATLOCK AND DISTRICT GAS BILL.

This was a Bill to incorporate and confer powers upon the Matlock and District Gas Company, and for other purposes.

Mr. BALFOUR BROWNE, K.C., and Mr. COURTHOPE MUNROE appeared for the promoters; the only opponents, the Matlock Bath and Scarthin Nick Urban District Council, were represented by Mr. WEDDERBURN, K.C., and Mr. C. C. HUTCHINSON.

Mr. BALFOUR BROWNE, in opening, said the area served by the Company included Darley, Tansley, Wensley, and Snitterton, and a tongue-shaped portion of Matlock Bath extending into the district of the Company; and it was proposed to take in Rowsley and Winster—an extension to which there was no objection. In 1896, the Urban District Council of Matlock Bath promoted a Bill for the purchase of the Gas Company who supplied within the major part of their district. This Bill became an Act; and in it a clause was inserted for the protection of the present promoters, to the effect that it should not be lawful for the Matlock Bath Council to supply gas within the present limits of the Matlock and District Gas Company unless they obtained the consent in writing of the Company. Such consent had never been given; and the result was that the promoters were supplying in the tongue of the Matlock Bath district. The real question raised by the petitioners had relation to a desire on their part to supply the whole of their district with gas, and therefore to obtain the insertion of a clause transferring to them the small area referred to. The proposal would break up the undertaking of the promoters, and to grant it would be contrary to the practice of Parliament. In certain cases where complaint had been made of the action of a gas company, there had been justification for taking over the company's undertaking as a whole; but he knew of no case in which a portion only of a company's undertaking had been compulsorily taken from them. In their petition, the Matlock Bath Council submitted that the houses and public lamps in the disputed area could be supplied more conveniently from their works, which were half-a-mile nearer than those of the promoters, and that they should be authorized to purchase the portion of their undertaking which was within their area. Counsel pointed out that a question of price was involved; for whereas the petitioners charged 3s. 7d. per 1000 cubic feet for gas, the promoters charged only 3s. It was easy to understand, therefore, that residents in the disputed area were not anxious to be supplied by the Matlock Bath Council. Ever since the Council purchased the gas-works in their area in 1896, they seemed to have made a muddle of the business. They had had a deficit each year, though it was not large, and they had apparently mixed up capital and revenue accounts in a way that was not at all commendable. A most patient and careful Committee in the other House heard the case, and decided against the Council. He believed it was only because the ratepayers were assured that the further opposition would cost them nothing, and that they had not had a fair hearing, that the present petition had been presented. He referred further to the petition in which, *inter alia*, the Council objected to the proposal to supply power gas. There were a number of hydropathic establishments in the locality, which the Company believed would take it. The Company would not supply it unless it paid; and in that event the consumers on the tongue of land would benefit as well as other consumers of the Company. The Council, really, were seeking to force the Company, merely by now opposing the Bill, to part with a portion of their district, although they had bargained in 1896 that the area was to remain a part of the Companys district.

Mr. *William Moxon*, the Chairman of the promoting Company, gave evidence in support of the Bill. He said it was proposed to increase the capital of the Company by £45,547, or with the usual borrowing powers, by £63,000; the present capital being £46,452. Authority to supply power gas also was sought. There had been frequent applications for it. Matlock being a health resort containing a large number of hydropathic establishments, it was very desirable that the smoke arising from coal consumption should be minimized, and that the place should be as free from dirt and dust as possible; and the use of power gas would tend to effect this object.

In cross-examination by Mr. WEDDERBURN, witness said that in the tongue of land in question there were, he believed, about 50 acres, about 53 houses, and 38 consumers of gas; and the earnings from it represented about 2 per cent. of the earnings of the Company. The promoters were prepared now, as they had been in 1896, to get out of the Matlock Bath District if the Council would get out of the Company's district—that was the portion of the Matlock urban district in which they had the power to supply.

Mr. WEDDERBURN: The difficulty is this, is it not: The Committee of Parliament in 1896, by clause 30, said to the Matlock Bath District: "You shall, if you like, buy up the whole of the Company's district—Cromford, Bonsall, and the bit in Matlock Bridge (Matlock Bath you have); but if you do that, you must come under terms that, upon the application of the Local Authority of Bonsall, Cromford, or Matlock Bridge, you will sell to them the portion of your gas area that is in their district." So that Matlock Bath, if applied to by Matlock Bridge to-morrow, would have to sell to them the portion of the undertaking that is in their area.

Witness: Yes.

So that whereas the Gas Company can give us the bit in dispute, we cannot give you the other piece, because we are bound to be in a position, if called upon, to be able to sell it to Matlock Bridge. That is, I think, the whole point?—Yes.

In further cross-examination, witness expressed a strong objection to part with the disputed area on the basis of the petitioners paying full compensation for loss of revenue.

Mr. WEDDERBURN pointed out that the offer to exchange, as suggested by witness, was somewhat unreasonable, seeing that the tongue of land had an area of only 50 acres, whereas the district which it was said should be set against it had an area of 1500 acres.

Tuesday, June 14.

Mr. BALFOUR BROWNE said that, unfortunately, their negotiations had been futile. The promoters had been prepared all along to give up to Matlock Bath the tongue of land on condition that Matlock Bath gave to the Company the portion of the Matlock urban district in which the Matlock Bath Council at present had rights; the gas consumption in the two areas being about equal. The Company could not give up the tongue merely for a portion of the other area, because the Local Authority objected; and, moreover, a similar anomaly to that which existed at present would result. An offer to exchange the districts in the way suggested—the difference in the value of the two districts (if any) to be settled by money compensation—was rejected by the petitioners.

Mr. WEDDERBURN said this proposal was merely an endeavour to complicate the question; and he could not accept it. The simple matter with which the Committee could deal by this Bill was the anomaly connected with the tongue of land. To deal with the other portion—the area proposed to be exchanged—would require another Bill. He was prepared to purchase the tongue, paying full compensation, and undertake that, if the promoters hereafter sought power to acquire the other area, the Matlock Bath Council would not oppose them.

Mr. COURTHOPE MUNROE said the Company were not willing to sell a portion of their area. They had better therefore proceed with the evidence.

Mr. *E. H. Stevenson* was then called. He said the present capital of the Company per million cubic feet of gas sold equalled £708. But they had no working capital; and therefore £3000 should be added to capital for this purpose, which would bring the figure per million up to £773. This would be very reasonable for a district like this. The additional capital sought (£62,990) would last for about twelve years. The growth of the district had been very rapid. In the last ten years the growth had been about 7½ per cent.; the figure for the first half of that period being 6·35 per cent. and for the latter half 9·27 per cent. In the past year the figure was 9·64 per cent. He assumed that the increase in the future would be at about the rate of 9 per cent. The Company had worked exceedingly well in the past, the percentage of unaccounted-for gas having been reduced to the low figure of 4·1 per cent. The price charged to consumers averaged 2s. 10·69d., the highest price being 3s. 4d., less 2d. This was very low compared with the prices charged by other gas undertakings in Derbyshire. At Matlock Bath, the charge was 3s. 7d. per 1000 feet. The Bill also contained common provisions for the conversion of the capital, for an insurance fund and reserve fund, and for the construction of a tramway. Authority was also sought to supply power gas. Already the Company supplied a considerable quantity of gas for power purposes; and they were informed that if they could supply at a cheaper rate it would be more extensively used. There was no doubt it was wanted here; smoky chimneys being a great nuisance in a district which was almost entirely residential except for quarries and paving works. He objected to the proposed expropriation *in toto*, holding it to be wrong that any portion of a district given to a gas company should be compulsorily taken from them. There was no precedent for such a proceeding. In this case, it would open the door to every one of the other local authorities. Whenever they wanted to acquire their portion of the undertaking they would say: "Parliament has already granted it in the case of one area; now we want it." So the Company would be slowly bled to death. The application in this case was made against the

case of a statutory company who had always done their duty, and done it well. Parliament had always refused such applications, and further than this, had protected existing gas purveyors in districts from other local authorities obtaining parliamentary powers over them. Here, too, the applicants were every day contravening their own Act; for that Act, passed in 1896, ordered them to shift their gas-works from the present site within seven years. Yet they had not done so. The exchange of area, referred to by Mr. Balfour Browne, would be a very right and proper way of settling the dispute; and if an Act was necessary to enable the transfer of the portion in which the petitioners were now interested, the expense should be put upon those who desired the exchange. The illuminating power of gas supplied by the Company was nominally 15 candles; but actually it was nearly 17. The nominal candle power of the Matlock Bath Council's gas was 18 candles.

In cross-examination by Mr. WEDDERBURN witness said that in the tongue, the Dale area, there were 38 consumers—26 taking gas by means of prepayment meters, and 12 ordinary consumers. The slot-meter consumers paid 3s. 9d. per 1000 cubic feet; all the consumers in the petitioners' district paid 3s. 7d. or 3s. 9d. per 1000 feet. He did not know that some of the twelve were discontented with the gas, nor that they had said the Company's supply was inadequate, poor stuff, and so on. Under section 30 of the Act of 1895, Matlock Bath, if required, would have to sell portions of their gas undertaking to the local authorities. If called upon to sell, the undertaking would be dismembered; but the Matlock Bath Council took their undertaking on that condition. If the Matlock Bath Council were to take over the tongue, it would not help to a settlement. He did not think the Matlock Council could call upon Matlock Bath to sell to them the portion of the Matlock Bath undertaking in the area of the Matlock Council and hand it over to the promoters. The permission of Parliament would be needed to do this; and he doubted whether this could easily be obtained. He did not know of any Act which had been opposed which gave authority to a gas company to supply power gas. In the present case, all the other local authorities were with them. If the capital expended worked out to £630 per million cubic feet, the £63,000 additional capital asked for would suffice for fifteen years, instead of twelve as estimated.

Re-examined: With regard to power gas, if the Company did not provide it, it could not be obtained. The nearest power company was at Derby, 18 miles distant; the country intervening being such as would not induce a company to lay mains through it to obtain the comparatively small business at Matlock. To meet Matlock Bath, the promoters were willing to insert a clause undertaking not to supply it in their area.

The CHAIRMAN: The Committee would like to know whether you have made any calculation as to the cost of supplying power gas?

Witness: No, I have not. The cost in capital will probably be the same as for coal gas. If we supply power gas, we shall use some of the capital for the purpose instead of for coal gas; and I think it will be about the same period before we come to Parliament again. That is why I did not put down anything for power gas by itself, because then I should have had to deduct a certain portion for the coal-gas plant. At present, we do not know how much coal gas would be taken off and power gas used; but I think it will be exactly, or as nearly as possible, the same.

Mr. *Thos. Brown*, the Manager of the Gas Company, also gave evidence in support of the Bill. He believed the recent rate of increase in consumption would be maintained. In the district asked for by the Bill, there were over 1000 houses not supplied, and 49 houses were under construction on the line of the Company's main. He believed there would be a considerable demand for power gas if the Company had authority to supply it. Only one complaint had been received from consumers in the tongue of Matlock Bath, and this related to the absence of pressure.

In cross-examination by Mr. WEDDERBURN, witness said there was no estimate in regard to power gas, and he had no idea as to the amount they would have to supply.

Mr. WEDDERBURN: Can you give me any parallel for asking for this authority in regard to power gas, without any estimate, no suggestion of the amount, no suggestion of what the plant is to be, or where it is to be?

Witness: I do not know whether Caterham has given an estimate; Buxton, I believe, has the power.

Mr. *Hy. Challand*, Manager and one of the proprietors of Smedley's, Limited, the largest hydropathic establishment in Matlock, examined by Mr. COURTHOPE MUNROE, said he was quite satisfied with the gas at present supplied by the Company. They were most desirous of having power gas. In his establishment, they used a large amount of ordinary gas for power purposes.

In cross-examination by Mr. WEDDERBURN, witness said his Company had a private arrangement with the promoters by which they obtained their gas for power purposes at a particular price. When asked to name it, he appealed to the Chairman; and on being further asked by Counsel what right the Gas Company had to make a preferential arrangement with Smedley's, he said his Company had protective clauses with them because they were the proprietors of the gas-works before the present Company took over the undertaking.

Re-examined: Under the bargain by which the gas-works were transferred to the present Company, his Company obtained certain privileges. By clause 20 of the present Bill, however, these privileges would be restricted.

Mr. *J. G. Goodwin*, a Director of the Rockside Hydro., stated that visitors to this establishment were often driven from the lawns and otherwise inconvenienced by the smoke from large chimney stacks. It was important therefore that the Gas Company should have authority to supply power gas, in order that these chimney stacks might be done away with. If the Company were not enabled to supply it, there was little likelihood of obtaining it elsewhere.

Cross-examined: If the promoters offered them power gas at a sufficiently low price, they would take it; if not, they would probably produce it for themselves. He would be satisfied if the Company charged 9d. or 10d. per 1000 cubic feet for the power gas.

Mr. *Josiah Smart* stated that he had two gas-engines, which last year consumed 900,000 cubic feet of gas. If he was able to get power gas from the Company, he estimated that he would save £50 to £60 per annum; and he would use more of it than he did of coal gas. If introduced in the district, there would be a demand for power gas.

Mr. *H. G. Hartley*, the Vice-Chairman of the Matlock Urban District Council, stated that this body had passed resolutions approving of the Bill, and protesting against the cession by the Company of any part of their gas area.

Mr. WEDDERBURN then addressed the Committee on behalf of the Matlock Bath Urban District Council. In reference to the proposals with regard to power gas, he quoted the statement of Sir John Brunner in connection with the Rickmansworth Bill: "We shall not pass the preamble with regard to power gas; and I think it my duty to say that I entirely agree with Mr. Woodall upon that subject. I think it is entirely contrary to public policy that the right to make power gas should be allowed in isolated places up and down the country everywhere. Just as it was adjudged to be improper to allow little spots to be taken out of the country for a supply of electrical power, so we think it is improper in the case of power gas." There was no precedent for what was here proposed. The case was extraordinary and peculiar, because there was no evidence from anybody who knew anything about power gas as to how far the district was adapted for the production of it. No details were given; and so the Committee were to leap in the dark as regarded price, kind of gas, estimates, and so on. The price was put at 9d. or 10d. per 1000 cubic feet, and then at 5d. Assuming it to be 8d, as four times the quantity of power gas was required to do the work of coal gas, the cost would be 2s. 8d. against 2s. 6d.; so that it would cost more than coal gas. Moreover, they had no capital to lay down the plant. The point as to ugly chimneys could be met by the use of the existing gas supply. The capital sought was £16,000 more than they ought to have. The increase in consumption from 1891 to 1902 was 7·50 per cent. He objected to taking the last year or two as the basis of future requirements, because that would be quite misleading. Assuming that at the end of the period stated—namely, twelve years—they would be producing one-and-a-half times as much as at present (an additional 62 million cubic feet), and that the capital expenditure was neither £630 nor £773, but something between—say, £750 per million cubic feet—the capital they would need would be £46,000, not £63,000. He therefore asked the Committee to cut down the capital powers to £35,000, with borrowing powers as to £12,000. Coming to the matter of immense importance, that regarding the tongue of land, there could be no doubt, he said, that if this bone of contention could be removed, it would be well to remove it; the money of the Company and of the Local Authority having been spent three times in a decade in contesting it. Now was the time to ask for its removal. The Company were seeking by a Bill of 106 clauses to obtain a firmer grip of their present area; and before doing that, surely the anomaly should be removed. The principle of the thing was admitted in 1896; but the petitioners had all along been unable to settle with the Company, because they desired to retain the tongue, in order that they might, if possible, squeeze from the Council more than was right. The Council had continually desired to meet the Company by taking the disputed area and paying every penny which the Company would lose thereby. The transfer would be on arbitration terms; and the purchase being compulsory, they would probably get more than they would lose. The action of the Company was a breach of the understanding, and an unfair going back upon their promise of 1896, when they said they were ready to deal reasonably with the Council. It was a breach of faith to say they were ready to agree, and then to refuse unless the Council exchanged 1500 acres for 50 acres. In addition to this, the Company said the Council should bring in a Bill to enable the 1500 acres to be transferred. Again, the principle was admitted; but unfair conditions were asked for in carrying it out. The resolutions of the Matlock Urban District Council emanated, of course, from the Gas Company, and were therefore worthless.

Mr. COURTHOPE MUNROE said neither the Chairman of the Matlock Council, who was a shareholder in the Company, nor any member of the Council who was also a shareholder, voted for or against the resolutions in regard to the Bill.

Mr. WEDDERBURN, continuing, asked what place was it of the Matlock Urban Council to protest against the cession of the tongue? It did not affect them; and where was the explanation except in the fact that on the Council there were a larger number of Directors of the Company? There was no substantial objection to the Matlock Bath Council having this little area; and he asked the Committee to make an advance by saying that they could have it on paying in full for it. If that were done, he would undertake not to oppose the Company if they sought in any way hereafter to acquire the other area. It was altogether unfair that the Matlock Bath Council should be called upon to promote a Bill sanctioning the transfer of the latter area. He asked the Committee to settle the matter—which the parties were apparently unable to settle for themselves—by saying that this bickering should cease on the terms he had suggested. He added, in conclusion, that he did not propose to call evidence.

The CHAIRMAN, after consulting in private with his colleagues, said: The Committee decide that the preamble is proved subject to this: With regard to power gas, we request that a clause be drawn up and submitted to us giving as much detail as possible with regard to the capital which will be expended upon it, what the various costs will be, and what the price will be to customers. We have nothing before us, or very little, now, in connection with power gas. There is another suggestion the Committee want to make to try to help to prevent further litigation in these matters. We do not ask for a clause to be put in, but that you should take it as a suggestion from us whether you cannot see your way to pulling yourselves together with regard to the tongue, in order that at some future time a Bill might be brought in, which would be unopposed, so as to prevent further litigation and anxiety. At present, we consider that the preamble of the Bill is proved. We only offer this as a suggestion.

Mr. WEDDERBURN: We are ready to consider that when they bring up the clause.

The CHAIRMAN: Yes; the two bodies sharing the expense so as to bring in an unopposed Bill, or a Bill that would be unopposed.

Mr. WEDDERBURN: We will bring up a clause. I think the suggestion of sharing the expense may be very helpful.

Mr. ANDERSON (Parliamentary Agent for the Bill). It is not the suggestion of a clause at all.

Mr. WEDDERBURN: The suggestion is that we should see what can be done.

The CHAIRMAN: In the future, not now. I am only offering it as a suggestion.

Mr. WEDDERBURN: I understand, if we desire it, as regards power gas, a clause will be put in that it is not to be supplied in the tongue without our consent.

Mr. COURTHOPE MUNROE: There is not the least objection to that.

Thursday, June 16.

Mr. COURTHOPE MUNROE said the promoters had prepared clauses to carry out the decision of the Committee. They were as follows:—

85*a*.—The Company may, for the purpose of supplying power gas, expend out of the additional capital by this Act authorized a sum not exceeding £15,000.

85*b*.—The Company may charge and receive in respect of power gas supplied by them such sums as may be agreed between them and the consumers, not exceeding the following prices: For power gas having a calorific power of 125 British thermal units 6d. per 1000 cubic feet; for power gas having a higher calorific power than 125 British thermal units, a further sum of 1d. per 1000 cubic feet for each additional 25 British thermal units. Provided that every person entitled to demand a supply of power gas from the Company shall be entitled to such supply on the same terms as any other person who is receiving a corresponding supply for a similar purpose in like circumstances, and the Company shall not, in making any agreement for affording a supply of power gas, show any undue preference to any person.

To meet the point of the petitioners with regard to the supply of power gas in their area, the following was proposed: The Company shall not supply power gas within that part of the Matlock Bath and Scarthin Nick urban district as is situate within the limits of supply of the Company, unless with the previous consent in writing of the Council of that district.

Some discussion took place with regard to the latter clause; the Parliamentary Agent for the petitioners submitting a provision which, from the point of view of draughting, they contended was preferable. In the result, however, the Committee accepted the one brought up by the promoters.

Mr. *Stevenson* was then called to explain why they could not carry out the decision of the Committee with regard to giving details as to the cost of power gas. He said he was not sure as to whether the Committee referred to the actual cost of the different portions of the apparatus or to the cost of manufacture. The cost of manufacture would depend largely on the sort of power gas supplied. It was intended to use gas of much higher calorific power than Mond gas, because it would be made from coke. It would be in the form of straight water gas mixed with the lower quality of coal gas; so that it would probably have a power of 400 British thermal units. What mattered to the public was not what it would cost the Company, but what it cost the public. The price of 6d. per 1000 cubic feet was low for a Company such as this. In the Mond Gas Act of 1901, the price was to be 3d. per 1000 cubic feet for gas of 125 British thermal units, if 4 million cubic feet per quarter or more were taken, and 4d. for smaller quantities. The Matlock Company did not expect any one consumer to take nearly as much as 4 million cubic feet. The maximum price of 6d. would not be charged if a large consumption were obtained.

The CHAIRMAN: Can you say what portion of the sum asked for will be applied to mains and what portion to the furnishing?

Witness: It is about half and half—rather less than half for the mains if we go to all those who we hope will take the gas from us. It is expected that some at a considerable distance from the works will take it in large quantities; and if they do, about 10 miles of main will be required. I estimate that the mains will be 8-inch, and will cost £700 per mile.

The CHAIRMAN: The Committee accept these clauses.

The remaining clauses having been adjusted, the Bill, as amended, was ordered to be reported to the House for third reading.

WEST MANCHESTER LIGHT RAILWAY ORDER.

The Question of Electrolysis.

The consideration of objections to this Order was before the Board of Trade last Thursday—Sir HERBERT JEKYLL, K.C.M.G., R.E., presiding.

Mr. VESEY KNOX appeared for the promoters, the West Manchester Light Railways Company; Mr. LEWIS COWARD represented the opponents—the Stretford Gas Company, and the Corporation of Manchester; and Mr. WEDDERBURN the Stretford Urban District Council, who also opposed.

Mr. LEWIS COWARD said he appeared on behalf of the Stretford Gas Company and the Corporation of Manchester, the latter in their capacity as owners of water-works and water-mains. The principal question before the Board was the electrolysis clause; and he submitted the following: "If it be proved that any injury or damage to any main, pipe, or apparatus of the Gas Company shall have resulted from fusion or electrolytic action caused by any currents generated or used for the purpose of electric traction on any of the railways for the time being belonging to, or worked by, the Company, nothing in the Board of Trade regulations or this Order shall relieve the Company from any liability to make compensation for such injury or damage which would have existed but for the said regulations and this Order." The learned Counsel said that chaos would exist in the area to which the Order related if the clause were rejected. Over one portion of the area there was already an Act of Parliament in operation which contained, in substance, the clause he asked for.

Sir HERBERT JEKYLL: What are the special circumstances on which you rely?

Mr. LEWIS COWARD said he had got, for the purpose of the argument, gas and water mains all along the roads and streets in the area. The question of liability for electrolytic action was one which had occupied the Courts for a great number of years. If the clause were refused, he would have over one portion of the lines a clause making the Railway Company liable for damage, and on another portion no liability, save only the model clause, which hitherto was the only one that existed; and that would produce chaos. He contended that the action of the Lord Chairman of Committees did not govern the Board of Trade in any way, and where this clause had been agreed between the parties the Board had always inserted it.

Sir HERBERT JEKYLL: That is doubtful.

Mr. WEDDERBURN, who was interested in the matter as the same clause was asked for in the Stretford Light Railway Order (the consideration of which would immediately follow), which the Stretford Urban District Council promoted, said the clause in the Act which had been referred to was due to an agreement between the promoting Companies, and not to an agreement between the companies and the local authorities.

Mr. *Holme Lewis*, the Engineer and Manager of the Manchester Corporation Water-Works and Hydraulic Power Supply, in answer to Mr. LEWIS COWARD, said that he had had occasion to study the effect of electrolytic action on pipes laid in the streets, and had arrived at the conclusion that serious damage was being caused to underground pipes by stray electric currents. He produced samples of iron and lead pipes which had been so damaged. They were taken from immediately under the rail. The pipes on either side, further from the rail, had been examined and found in a good condition. He maintained that, from evidence and from experiments made, it was clear that, where a pipe passed at right angles to the rails, and in close proximity to them, and where the soil was such as to conduct the current into limited areas, the pipe would be damaged, even under the present conditions of working.

Sir HERBERT JEKYLL: Only when crossing at right angles?

Witness: I would not say only then; but it is peculiarly liable under those conditions. Continuing, he said he did not know how long the pipes had been subject to the electrolytic action, because they were only taken up when a leakage occurred; they were not searched for. The tramways had been running some 15 months before the leakage broke out.

If your theory is correct, this amount of damage has been done in 15 months?—That is so.

Witness, continuing, added that he had an analysis of the soil, if any question arose upon it. He produced a sample of hydraulic pipe with a 1½-inch bore taken up from near the centre of the city of Manchester, which had formed a branch pipe from the trunk main into one of the premises supplied with hydraulic pressure. This also passed under the tram-line, and was the only length out of six forming the total branch that was damaged. He explained that each joint of a hydraulic pipe was insulated. It was made of gutta-percha; and the current could only pass along the bolts forming the joints, which were frequently badly corroded. There was no proper contact. He also produced two nuts, which proved, as he submitted, that the current passed along the bolts. They indicated that the current had got into the bolt, and passed into the nut on its way to earth. He had a large number of damaged pipes, which could be produced, if necessary.

Sir HERBERT JEKYLL: Do all these cases allege that electrolytic action took place where the pipes crossed under the tramway, not running alongside?

Witness: Not exclusively.

Does the same effect occur if the pipes run alongside the tramway?—Yes; but the worst cases we have noticed are under the rails. We have no instances on record outside the area covered by the tram-lines.

Cross-examined by Mr. VESEY KNOX: There is no chemical difference whatever between electrolytic action on an iron pipe and ordinary corrosion?

Witness: There is a difference in the action on the pipe.

You know Professor Dewar is of opinion that there is not?—I have not seen the statement.

He has been called as a witness for gas companies; and, in his opinion, there is no chemical difference whatever.—There may be no chemical difference.

If the electric current were seeking somewhere to go, the hydraulic main, the joints of which are covered with gutta-percha (an insulating material), would be the last place it would go to?—Not at all. The current would reach the body of the pipe, because of its mass; it would not travel beyond a length, probably, on account of the resistance of the joints.

Mr. VESEY KNOX, for the promoters, submitted that the evidence, although perfectly frankly given, was of an entirely inconclusive kind. Even if the electrolytic action existed, it would still have to be proved that the current which did the damage had escaped from the tramway works.

Sir HERBERT JEKYLL said that they would report to the Board, and the point would be considered with great care. It was not the first time that the case had been argued before them. He would be sorry to encourage any expectation that the protection which the Board had reason to believe had proved sufficient in the past would not be held to be sufficient in the present case.

Further objections were then considered.

Cleckheaton Gas Supply.—During the year ending the 31st of March, the quantity of gas made at the Cleckheaton Gas-Works was 105,037,000 cubic feet. The leakage was only 6·93 per cent., compared with 11·64 per cent. in the previous year. The average cost of coal was 10s. 7·65d. per ton; and the yield of gas was 10,822 cubic feet per ton. The gross profit amounted to £3928; and adding £600, the estimated cost of free street lighting, it is equal to 15·56 per cent. on the capital employed (£29,100). The charge for gas is 2s. 8d. per 1000 feet, with 10 per cent. discount to lighting consumers for prompt payment, and 15 per cent. to other consumers.

LEGAL INTELLIGENCE.

CHARGE OF SELLING SPURIOUS WELSBACH MANTLES.

At the North London Police Court on Tuesday, Woolf Weisberg, described as a Roumanian subject, of Newbold Street, Commercial Street, E., was charged, on remand, on a warrant, before Mr. Fordham, with unlawfully and falsely applying to certain incandescent gas-mantles the registered trade mark of the Welsbach Incandescent Gas-Light Company, Limited, contrary to the Merchandise Marks Act, 1887. Mr. Bodkin prosecuted; Mr. Yardley Tilley defended. The accused, who had been out on bail in one surety in £100, elected to go for trial. Mr. Bodkin said the prosecutors were the proprietors of a registered trade mark, "A.U.R.," which was applied to every one of their mantles, together with the name "Welsbach." The Company found that spurious mantles, bearing these marks, were being imported into this country by thousands; and prosecutions had taken place in Liverpool and other places. The Company thought they had at last found the centres from which these mantles were distributed—Spital Square, E., and Daleview Road, Tottenham. It had come to their knowledge that a firm existed in Berlin whose business was to manufacture these spurious articles; and they were consigned to this country to the "Front Incandescent Gas Lighting Company," which was carried on by several men—by the prisoner, it was alleged, especially. The prosecutors became aware of the spurious mantles which were being foisted upon the public by the many complaints that had come to hand. They guaranteed all their mantles; and hence the complaints. The prisoner had been seen actively engaged in carrying on the business of labelling and packing the articles in question, both at Spital Square and Daleview Road; and it was pretty clear that he was more than the mere servant he represented himself to be. A mass of correspondence had been found, which went to show that he suggested to the Berlin people that the printing of the wrappers and labels should be left to those who received the goods in England. It seemed that he negotiated for the production of 50,000 labels, almost an exact imitation of that which was pasted on the genuine article. Warrant-sergeant Popham, who is attached to the Court, with Mr. Goodyear, of the Welsbach Company, and others, made a raid upon the house at Daleview Road. They found there the accused, two other men, and a woman. They seized a large number of labels, and 11,827 mantles. Mr. Fordham again remanded the prisoner; increasing the bail to two sureties in £250 each.

On Friday, the accused was brought up in company with Max Strauss, described as a traveller, of Daleview Road, South Tottenham, and both were charged with being concerned in causing to be made and imported spurious imitations of the Welsbach Company's mantles. When Warrant-Sergeant Popham arrested Weisberg, he found him pasting imitation Welsbach labels on the cases containing the spurious mantles. The officer at the same time seized 11,827 imitation mantles and a large number of infringed labels, all of which were brought into Court. He stated that on the previous Saturday he went to Carter Paterson's depôt in Church Street, Stoke Newington, and seized a case containing 5916 mantles. Mr. Bodkin said the case bore the name of Max Strauss, and was addressed to a place at Newcastle-on-Tyne. Mr. W. MacKean, Chemist in the service of the Company, said the spurious mantles seized were not manufactured by them, though they bore the trade mark "A.U.R." and "Welsbach." Mr. Tilley, on behalf of Weisberg, said that if the case was to go for trial he would not now call witnesses, and would reserve his defence. Mr. Fordham said he should commit both prisoners for trial at the Central Criminal Court. Strauss (who was undefended) said he had a statement to make and a witness to call. As it was past five o'clock, the accused were formally remanded till the next day.

On Saturday, they were brought up again before Mr. Fordham, and Strauss endeavoured to show that he was only the servant of Hertz, whom the prosecution alleged to be a partner with Weisberg and Strauss. After evidence had been given, the prisoners were committed for trial, bail being fixed at two sureties in £250 each, with notice to the police.

The Water Companies' Appeals to the House of Lords.

At the sitting of the House of Lords on Monday last week, Mr. Balfour Browne, K.C., renewed an application, which had been mentioned to their Lordships on the previous Friday, for the advancement of the appeals from the decisions of the Court of Appeal on the amounts of compensation to be paid to the several Water Companies under the awards of the Board of Arbitration. The learned Counsel stated that the 24th inst. was the date proposed for the transfer of the undertakings, but until a decision had been given by their Lordships, the Board could not fix the sums necessary to complete the purchases. The Lord Chancellor said it might be unfair to other suitors to advance the appeals; but if Sir Edward Fry (the President of the Court of Arbitration) would send him a letter confirming Counsel's statement, their Lordships would consider the question.

Mr. Arthur Kitson and the Kitson Lighting Company.

In the Court of Appeal, last week, the Master of the Rolls and Lords Justices Stirling and Mathew gave judgment in the appeal brought by the above-named Company against the decision of Mr. Justice Channell, holding them liable in damages for the wrongful dismissal of Mr. Arthur Kitson as Managing Director. The proceedings in the Court below were reported in the "JOURNAL" for Nov. 10, 1903 (p. 359). The case had been argued on two preceding days by Mr. Gore Browne, K.C., and Mr. E. Bray, on behalf of the appellants, and by Mr. Dickens, K.C., and Mr. Disturnal for the respondent. Their Lordships came to the conclusion that Mr. Kitson had been wrongfully dismissed, and refused to allow the appeal, with costs.

MISCELLANEOUS NEWS.

THE COMMITTEE ON METROPOLITAN GAS TESTING.

Abstract of the Evidence.

We commence to-day an abstract of the evidence submitted to the Departmental Committee on Gas Testing, who sat at the Board of Trade, Whitehall, earlier this year, and whose report was published in last week's issue of the "JOURNAL" (p. 728). The Committee consisted of Lord Rayleigh, F.R.S. (Chairman), Sir William de W. Abney, K.C.B., F.R.S., Dr. Robert Farquharson, M.P., Mr. William King, M.Inst.C.E., and Mr. J. Fletcher Moulton, K.C., M.P. Mr. Herbert C. Honey was appointed Secretary.

First Day.—Monday, Feb. 8.

Mr. A. G. VERNON HARCOURT.

The first witness examined by the Committee was Mr. A. G. Vernon Harcourt, one of the Metropolitan Gas Referees, who gave an account of gas legislation—enlarging upon points which he thought might come before the Committee. He began by explaining that the reasons for imposing statutory requirements upon the Metropolitan Gas Companies were stated in the preamble of the Metropolis Gas Act, 1860. These reasons were that the Companies had agreed as far as possible to confine their supplies to separate districts, which arrangement it was deemed expedient should receive the sanction of Parliament; and that the regulations to which the Companies were subject not being uniform, it was advisable that provision should be made for the due regulation of all Companies supplying gas within the Metropolis. Briefly, the supply of gas, ceasing to be competitive, became a monopoly, and therefore needed for the protection of the public to be placed under regulations in regard to its quality and price. This, which was the foundation of those parts of all the Metropolitan Gas Acts which related to testing and price, answered the plea which might otherwise seem reasonable—"All we ask is to be left alone with our consumers." In the Act of 1860, the prescribed illuminating power was 12 candles; the burner to be used being an argand having fifteen holes and a 7-inch chimney. This corresponded nearly to the illuminating power of 14 candles prescribed by the City of London Gas Act, 1868, when the burner to be used in testing became that selected by the Gas Referees (who were appointed under this Act)—namely, Sugg's "London" argand, No. 1. Owing, therefore, to the change in the testing burner, the illuminating power of gas which, with the earlier burner, would have been taken to be 12 candles, became about 14 candles. Subsequently, the prescribed illuminating power for all the Companies was raised to 16 candles; and the burner which had hitherto been prescribed for use in testing by the Gas Referees was fixed by Parliament.

Having referred to the sections in the various Acts of Parliament bearing on the subject of testing, witness proceeded to deal with the Bill which was introduced in 1900 by the South Metropolitan Company, in which it was proposed to extend the sliding-scale to the illuminating value of gas, so that the standard price should vary according to the candle power. The suggested variation, however, was, he said, very far from being proportional. A similar concession of liberty to simultaneously lower the illuminating power and price was made in the City of London Gas Act, 1868. From Sept. 30, 1868, until Jan. 1, 1870, the illuminating power of the gas was to be not less than 14 candles; and after this it was to be 16 candes. But by agreement, 14 or 15 candles might be substituted for 16 candles in 1870, with a proportionate reduction of price at the rate of 2½d. per candle. The reduction proposed by the South Metropolitan Company was 1d. per candle. It might have been due to this lower estimate of the importance of illuminating power (some justification for which was afforded by a change in the manner and purposes for which gas was used) that this suggested extension of the sliding-scale, which possessed several advantages, was not adopted. Two most important changes, however, were sanctioned by the Committee to whom the Bill was referred. The first of these was a lowering of illuminating power from 16 to 15, and then to 14 candles, for which concession the initial price was reduced from 3s. 3d. to 3s. 2d., and then to 3s. 1d. in the two cases. The second was a further lowering of illuminating power to the extent of about 1 candle by a change in the method of testing. The effect of this change did not appear to have been explained to the Committee; and the concession of a third candle was not balanced by any further lowering of the initial price.

In the parliamentary session of 1902, the Commercial Gas Company obtained an Act providing that the illuminating power of gas supplied by them should be 14 candles. In the Bill there was a clause prescribing the method of testing which had been sanctioned in the case of the South Metropolitan Company; but on this occasion the change was opposed by the London County Council, and the clause was dropped. The change in illuminating power from 16 to 14 candles was accompanied by a change of initial price from 3s. 9d. to 3s. 3d. The Gas Referees, having to prescribe the method of testing the 14-candle gas supplied by the Commercial Company, decided that it must be in accordance with previous Acts, which assigned to the term "14-candle gas" the following meaning: "Gas of such quality as when consumed by the standard burner at the rate of 5 cubic feet per hour gives a light equal to that of 14 candles." Since, however, the South Metropolitan Company had obtained a method of testing which allowed greater latitude, the Commercial Company were naturally desirous of being placed in the same position; and with the consent of the London County Council, and in view of the appointment of the Board of Trade Committee, they secured last year an Act entitling them for three years to have their gas tested in the same manner as that of the South

Metropolitan Company. The statutory requirements relating to the illuminating power of gas in the Metropolis, and the methods now adopted for testing, might therefore be summarized as follows: The Gaslight and Coke Company, not less than 16 candles; and the South Metropolitan and Commercial Companies, not less than 14 candles, as specially defined. By 16-candle gas was meant "such gas as when burning from the standard burner (Sugg's 'London' argand No. 1) at the rate of 5 cubic feet per hour gives a light equal to the light of sixteen standard candles (sperm candles of six to the pound, each consuming 120 grains per hour)." The definition of 14-candle gas was (except in the case of two Companies) the same, substituting "fourteen" for "sixteen" standard candles, and using a slightly narrower chimney—6 in. by 1⅜ in., instead of 6 in. by 2 in. The South Metropolitan and Commercial Companies were entitled to have their gas tested by burning it at such a rate as should give a light equal to 16 candles. The method of calculating the illuminating power of the gas from the observation of the rate of consumption was not stated in the Acts, but was probably intended to be that which had been prescribed by the Referees for gas of the normal value of 16 candles, the actual value of which might vary from 15½ to 17 candles. It was to be regretted that the South Metropolitan Company should not have obtained from the Parliamentary Committee the right to supply gas of lower quality otherwise than by altering the meaning of the term "14-candle gas," which as used up till quite recently in all Provincial Gas Acts in which the prescribed number of candles was 14, was quite definite.

Of course, the Referees stood in quite a different relation to questions of illuminating power from that in which they stood in regard to purity. The illuminating power, and the burner by which the test should be made, were prescribed by Act of Parliament; whereas, with regard to purity, not only the modes of testing, but also the decision as to the amount of impurity allowed, was remitted to the Referees. To the latter, however, there was one exception; in the Acts of all three Companies, it was provided that the gas should be wholly free from sulphuretted hydrogen. Witness said he ventured to think that this section of the Acts (which first appeared in the City of London Gas Act, 1868, and had been reproduced without change ever since) was unreasonably stringent, and did not recognize that in such a case absolute purity was unattainable. The mode of testing prescribed by the Referees would show the presence of a very small proportion of sulphuretted hydrogen, and had been accepted as sufficient by the Chemists of the London County Council and by consumers, though it would not be difficult to prove that gas which passed this test was not wholly free from that impurity. The fact was that the Referees had understood the instruction of the Act *cum grano*. They knew it was impossible to absolutely remove the whole of an impurity from gas; and though the terms of the Act were so stringent as not to authorize them to allow the presence of any amount, they thought a test might be prescribed which was abundantly severe—far too severe, the Committee would hear, in the opinion of those who were interested in the supply of gas—but yet by no means so severe as it would be possible to devise. The Companies did not often fail to pass the test—perhaps once or twice a year. It was possible as a rule to comply with the test; but naturally the Companies had a very strong feeling—and especially the managers of gas-works—against ever being found to supply what would appear in the papers as "impure" gas, or what might bring them before a Police Magistrate, or even require an appeal to the Chief Gas Examiner. Only a few weeks previously, they had two specimens of test papers which were slightly browned by sulphuretted hydrogen, which was worse than any other form of sulphur impurity.

The Chairman, referring to a clause in the Gas Referees' notification—"If the distinct discolourization of the surface of the testing paper is known to have taken place"—asked whether the introduction of the word "distinct" was not due to the Referees, and not to the Act. Witness replied that he was afraid it was; and he did not know whether they had any right to put it in. It was intended to be to a certain extent a mitigation or relaxation. The Referees thought the test was really a little severe. There were complaints that an extremely minute quantity brought these ill-consequences on the Company; and the Referees thought they might put in a sort of instruction to the gas examiner that he was not to report the presence of sulphuretted hydrogen unless he could be quite sure. This instruction was, he thought, more than sufficient for practical purposes; if there was not a distinct discolouration, it practically made no difference. There were good reasons for requiring a higher degree of purification from sulphuretted hydrogen than from any other sulphur compounds. The injury to gas-fittings was *nil* by other sulphur compounds; but the brass would be acted upon if there were at all a considerable amount—as much as there was of other sulphur compounds—of sulphuretted hydrogen present. Its almost complete removal, however, could be effected by processes which were simple, unfailing, and comparatively cheap.

The method of testing which was in use previous to the Acts of 1868 and 1869 (as described in section 25 of the Metropolis Gas Act, 1860) was, witness thought, sufficiently stringent for the purpose. Or it might be well to empower the Referees to prescribe, as in the case of other impurities, the amount of sulphuretted hydrogen to be permitted. Probably such a quantity as 1 grain (2·7 cubic inches) in 100 cubic feet of gas, or about 1 part by volume in 63,500, would be quite innocuous; but the delicacy of the present test was said to go far beyond this. He would like the Committee to understand that, though the extreme stringency of the test for sulphuretted hydrogen had often been put before Parliamentary Committees as showing the pedantry of the Referees in their requirements, the matter had not rested with the Referees at all; and if they had erred at all, it had been on the side of going within, and not beyond, the requirements of the Act. The restriction which had occasioned far more difficulty to the Companies than any other was that which limited the amount of sulphur present in compounds other than sulphuretted hydrogen. The most abundant of these compounds was carbon bisulphide. The amount of sulphur present in crude coal gas in this form varied from 20 to 30 grains; and if this could be removed as completely as sulphuretted hydrogen, there would not be more than 7 or 8 grains of sulphur per 100 cubic feet in the purified gas. As was well known, lime which had been acted upon by sulphuretted hydrogen, and thus converted into calcium sulphide, arrested carbon bisulphide, forming a sulpho-carbonate; but unfortunately this compound was unstable. Carbonic acid—and even, it was said, an excess of sulphuretted hydrogen—decomposed it, reproducing carbon bisulphide, which might thus suddenly make its appearance in increased quantity. The temperature of the purifying boxes, and the consequent dampness or dryness of their contents, also affected their efficiency. Another source of difficulty to the managers of gas-works which had dwelling-houses near them was the offensive smell of lime which had been used for purifying gas. Oxide of iron, the chief alternative agent of purification, had the great advantage that, when taken out of the purifying-boxes, it had comparatively little smell, and soon by the action of the air became quite inoffensive. But neither the oxide of iron nor the sulphide into which it was converted, arrested carbon bisulphide. Hence, if it was judged that, for use in rooms with the ordinary amount of ventilation, it was essential that gas should not contain, on the average, more than 10 or 12 grains of sulphur per 100 cubic feet, a sulphur maximum such as was at present prescribed by the Referees must be maintained. This year the Referees had made a change in their prescription of maxima which they hoped would help to relieve the managers of gas-works who were doing their best to supply well purified gas from the mortification of having (owing to a sudden and brief rise in the amount of sulphur, of which the cause might be obscure) subjected their company to a fine for supplying impure gas. Witness pointed out that he used the word "obscure," because where the cause was not obscure it might be laid before the Chief Gas Examiner to decide whether it was an "unavoidable cause or accident." His own belief was that there were cases in which it would not be possible to raise that plea, because ignorance could scarcely be pleaded by the gas manager with regard to a matter as to which he might be expected to know everything. Mr. Moulton: "Then you do not consider that because a cause is quite unknown it may yet be fairly said to be unavoidable?" Witness: "I was not sure whether it would be possible, without saying what the cause was, to plead that the cause was unavoidable. I should not like to offer you an opinion upon a point of that kind." Mr. Moulton: "You think it is a little difficult to 'avoid' what one does not know?" Witness: "It is a little difficult for a gas manager to explain how it was that he could not avoid something which, it may be, through lack of observation of what he ought to have observed, he is unable to specify. It might happen in various ways. It might be through not sufficiently regarding a change of temperature of the air, or in the quality of the coal which might be observed beforehand by tests, or it might be simply through the manager not having worked the purifiers with sufficient care."

Continuing, witness said that the new provision to which he had referred was that if at any testing-place the average quantity of sulphur for the past thirteen weeks should have been less than 12 grains per 100 cubic feet of gas—which the Referees thought was a reasonable amount to permit—the maximum allowed should be 27 grains, in place of the smaller maxima otherwise in force. The Referees believed that this provision, while affording relief to those responsible for the purification, would also encourage them to maintain as low an average as possible, and would thus be advantageous also to the consumers. They had not a separate limit for the quantity of carbon bisulphide. As the result of a great many experiments, witness had found that he could get gas almost absolutely free from sulphur; but he discovered no way in which he could do this without also reducing the illuminating power. There were in the gas 7 or 8 grains of sulphur in a form in which they were not arrested by any known purifying agent; and he thought that if this amount, *plus* a small quantity of carbon bisulphide such as would raise the total from 7 or 8 grains to 11 or 12 grains, remained in the gas, nobody suffered. After the gas was burnt, it made no difference whether the sulphur was in the form of sulphuretted hydrogen or carbon bisulphide. It was all absolutely burnt out if the combustion was really complete. With a flame placed in a draughty position, where the carbon was not completely burnt out, very probably some of the sulphur would escape; but this would not happen in ordinary cases.

Turning to the question of ammonia, witness said the maximum allowed was 4 grains, which was substituted, about 1880, for a lower figure, at the request of one of the Companies, and had not been challenged since. The removal of ammonia was one of those fortunate cases in which what would be a mischievous impurity had a considerable commercial value. It rarely happened that there was any complaint with respect to the presence of ammonia; the trouble was with the sulphuretted hydrogen and the other forms of sulphur. There was no difficulty in keeping the ammonia down to the amount prescribed, and his view was that, if the quantity of sulphuretted hydrogen were allowed to be something like five times as great as it now was, nobody would be the worse, and the Companies would then keep below the limit as uniformly as they did in the case of ammonia. If the test were nominally less strict, he thought the Companies would continue to keep the sulphuretted hydrogen down to about its present amount. Possibly they were now a little more particular than they would be if they had a rather larger margin: but there would be no difficulty, with the existing methods, in keeping the sulphuretted hydrogen within a limit little wider than the present one. He did not think there was any desire on the part of the Companies to substantially change the purity of the gas so far as sulphuretted hydrogen was concerned. If the change were made, there would be a little more sulphuretted hydrogen in the gas; but the whole quantity dealt with was exceedingly small, and in the ordinary use of gas it was completely burnt. Suppose the Companies were allowed to have 1 grain of sulphur in the form of sulphuretted hydrogen per 100 feet of gas, and if it were the case (as he believed it was) that they could not keep the total amount of sulphur present in other forms at less than 11 or 12 grains, then when the gas came to be burnt, the addition of this 1 grain was a small matter, and would give them complete relief. The question rather concerned the testing of the gas than its behaviour; it would behave just the same, but the test would have to be changed. It would be easy to devise a test which would permit some, but not much,

sulphuretted hydrogen. It would not be difficult to have a test which would definitely indicate the presence of so small a quantity as 1 grain per 100 cubic feet; and in this case there would be a return that the amount of sulphuretted hydrogen was not larger than was allowed—just as was now done in the case of ammonia. He felt sure he could design such a test. In reply to the Chairman, witness repeated that it was more important to remove the sulphuretted hydrogen than the carbon bisulphide. It would be found that the gas-taps would stick very much if there were any considerable quantity either of ammonia or sulphuretted hydrogen in the gas. The 1 grain of sulphuretted hydrogen to which he had referred would not make the gas smell perceptibly worse; but in any case this point was of no importance, as the bad smell of gas was useful as a danger signal.

The Chairman next asked witness whether he had any views to put before the Committee upon the general question of the importance of testing gas for purity. Witness replied that the question probably divided itself into two parts—first, whether there was a case for requiring the present degree of freedom from sulphur in gas; and, secondly, whether the tests which had been devised by the Referees were sufficient. When gas was less well purified than was now the case, he had sometimes noticed in his room a smell of sulphurous acid, and on testing had found the amount was perhaps 10 grains more than usual. It might be that on these occasions the quantity was nearly 40 grains, when it was generally (say) 30 grains. He was speaking of Oxford, which was not under sulphur regulations, and where the amount used to be larger than in London. The Referees had maintained with some doubt the difference between the amount allowed in winter and summer. The representatives of the Companies differed on this point a little. Sir George Livesey had held recently that it was quite unnecessary to make the distinction; and the Referees had thought of putting a mean value, such as 20 grains, which was the old limit, in place of 17 grains in summer and 22 grains in winter. Others, however, took a different view. Mr. H. E. Jones said the difficulty of keeping down the amount of sulphur in winter (when the make of gas was much larger relatively to the capacity of the purifying boxes) was much greater than in summer. It was in this belief that the distinction was originally made; and the Referees were discouraged by that opposite opinion from prescribing a uniform limit. The Chairman: "When the Referees decide on the figure to be adopted for these limits, do they assume without inquiry that the reduction should be carried to the greatest possible point that can fairly be imposed on the Companies, or do they consider the question of policy as to the amount of public advantage that arises from diminishing the amount of impurity?" Witness: "Both, I think, and also the question—which they are bound by the Act of Parliament to consider—of the difficulty which the Gas Company may have in avoiding nuisance in the neighbourhood in which the works are situated. I would add that this question is now of much less importance than it used to be when the gas was being made—as it was until a few years ago—in Lupus Street, Pimlico. With the class of house that was in the neighbourhood, it was much more difficult than in many works in less good neighbourhoods to avoid nuisance; and, of course, generally there is very much more difficulty in urban than in suburban works. Now so large a proportion of the gas is made at the large works situated outside London, that the difficulty of avoiding nuisance is much less than it used to be." The term "nuisance" would include everything—injury to health, damage to property, and, he should think, also an unpleasant smell, though it might not be injurious. There was no possibility of the point being approached at which the amount of sulphuretted hydrogen, in the case of an escape of gas into the air, would be dangerous. A person would in any case be killed by the carbonic oxide before he would be affected by the sulphuretted hydrogen.

Witness said the Committee might take it that he would favour a relaxation of the present stringency as regarded sulphuretted hydrogen, but that he would maintain the standard as regarded the other forms of sulphur. It would be better for all tests to be quantitative; but in the case of sulphuretted hydrogen the amount should be kept as low as 1 grain. As to the change in the 1904 notification of the Referees, in which the average amount of sulphur was taken into account as a relaxation of the stringency of the requirements, this was made by the Referees on their own authority. Mr. Moulton: "What puzzles me is this: If the Companies have been supplying for thirteen weeks less than 12 grains per 100 cubic feet of gas, there is a relaxation. You allow them to go up to 27 grains. Does not that permit them to go up to 27 grains for many weeks?" Witness: "All the time they were going up to this higher point they would be damaging their average for a time to come; and the period over which the average is taken is a variable period. Strictly speaking, if they were near the point of 12 grains on the Monday, and were for two or three more days to be near the 27 grains, they would cease to get the advantage of our new provision, because their average for 'the past thirteen weeks,' including day by day the high sulphur which had been found in the gas on each day, would itself be rising." Roughly speaking, it amounted to something like one week's latitude for every grain below 12 grains that the Company had attained on an average—that was, supposing they went to their utmost limit of 27 grains.

In answer to a question as to whether the objection to the presence of too much sulphurous acid was supposed to relate to the ground of of health, or to damage to furniture, and so on, witness said that on one occasion when he was asked to report on the state of the air in the library of the Athenæum, he was unable to find sufficient evidence to prove the correctness of the theory that the injury to the bindings of the books was due to sulphurous acid found. Certainly, there was damage to the books, and sulphurous acid was present; but acid might have been used in dressing the leather or in the process of binding. He was not sure it was proved that it was the sulphur in the gas that was the cause of injury to books, though he had little doubt that books would last longer in a room that had no artificial lighting. The carbonic acid might contribute to the ill-effects; but, at any rate, there were other products of gas consumption besides sulphurous acid. Books kept in libraries lighted by oil-lamps had been said to rot in the same way. If the purification were carried out wholly by oxide of iron, if none of the bisulphide of carbon which was normally present in coal gas were removed, then the amount of sulphur in the air in a room lighted with an ordinary quantity of coal gas would be prejudicial generally—possibly to health—and injurious to books and articles of furniture; but he thought that with purification as now conducted, no injury arose. Some medical authorities had held that sulphurous acid, or at any rate some form of sulphur, was beneficial to health—that it was an antiseptic; and witness believed this to be the case. He remembered being told at the Oxford Gas-Works that croupy children were sent to the purifier-house in order that they might benefit by the sulphur. The sulphur present in the air of London was chiefly due to coal. There could be no doubt that qualitatively sulphuric acid was formed in a gas-lighted room; but the quantity was not large. A great deal of it must be neutralized by the carbonate of lime in the ceilings. A stream of it would rush from the burner to the ceiling, and get fixed there as calcium sulphate. Taking all the probabilities of the case, a large amount of sulphur might be injurious to health and property.

Passing on to another subject, witness said, in answer to Mr. Moulton, that in his experience there was complete combustion in the gas-burners ordinarily used—that was in still air, with a fairly steady flame. Imperfect combustion in stoves was much more apt to occur with atmospheric than with luminous burners; but provided a bunsen burner was left to burn freely, combustion was complete. With incandescent lighting there was not imperfect combustion if the mantle was properly managed.

As to the test for sulphuretted hydrogen, witness did not think that under the existing Act it would be wise or lawful to make it more lax, nor that there was any real reason for making it more stringent. He believed (though he had made no experiments) that 1 grain would blacken the test paper very distinctly. Witness said he regarded as satisfactory the Referees' test for sulphur in other forms; and he described the principle of this test to the Committee. After stating that the ammonia test was also quite satisfactory, he gave an account of the substitution by the Referees of the 10-candle lamp for candles in testing for illuminating power, and the method of testing by observation of the rate at which the gas was burning. The latter, he thought, was better than the old plan of burning the gas at a stated rate and reading off the illuminating power, because it went immediately to the point that affected the consumer—namely, the quantity of gas he had burnt to obtain the light he had enjoyed. The consumer could not see any difference according as the gas was of 15 or 17 candle power; he simply consumed more gas—that was to say, he turned on the tap until he got the light he wanted. Flames extremely similar in size, steadiness, shape, and illumination could be produced over a considerable range by gas of different illuminating power; and if one had to go (as he thought one would go) by simply turning on the tap gradually until one obtained a satisfactory flame, probably the point at which one would stop would be when there was as much illumination with a gas of lower power as was secured perhaps the day before with a gas of greater illuminating value. The only difference would be that which the meter would show. A man would probably be guided by the look of the flame; and in adjusting the tap the flame arrived at would be very similar to that with the higher-quality gas on the previous day in respect of the light given; but it would be found that there was a difference, which would be on the average inversely proportional to the illuminating power of the gas in the two cases. The French mode of measurement was not to speak of the gas having an illuminating power of such and such value, but as being so many *litres* gas—meaning that it was necessary to burn the gas at such a rate in order that it might give the same light as the Carcel lamp. He preferred this method. The Referees would not have ventured on their alteration, if they had not satisfied themselves that the results were very slightly different by the two methods.

Being asked by the Chairman whether he approved of the application to 14-candle gas of the method of testing which they had been discussing, witness said he disapproved of it as altering one of the fixed points in the nomenclature of illuminating power. They had arrived, he thought, at something pretty definite when the burner was finally adopted and put into the Act of Parliament as "Sugg's 'London' argand, No. 1;" and at the time when the burner was first adopted, the coal gas which was being tested was 14-candle gas. The meaning of "14 candles" was then quite well understood. It meant a definite thing—that the gas burning in a particular burner at the standard rate of 5 cubic feet per hour gave a light of 14 candles. The effect of the alteration made for the South Metropolitan Company by their Act of 1900 was to upset this definition, which he regarded as somewhat unfortunate for gas testing, because taking the light given by a Sugg "London" argand burner with gas burning at the rate of 5 cubic feet per hour the valne of the gas was by no means the same as if one inferred it from the rate of the gas burnt in the same burner so as to give a much greater light. Gas of 16-candle power might also be made into 16½-candle gas if the method of testing it were altered in the same way. With coal gas properly so called, as opposed to water gas, the burner could hardly be used for testing gas which was of greater value than 17 candles. With the water gas now supplied mixed with coal gas, the flame was shorter; and it was not difficult to get a light of (say) 18 candles if one burnt a sufficient quantity of it. Following the method which the Referees had adopted, and inferring the illuminating power from the rate of burning, a different value would be given to 16-candle gas if the direction was that it was to be so burnt as to give a light of 18 candles. In the same way, the direction which was now given that 14-candle gas was to be so burnt as to give a light of 16 candles, passed under the name of "14-candle gas" gas which was of considerably less value than what used to be termed 14-candle gas. In fact, it was 14-candle gas burning 5⅝ cubic feet per hour, instead of 5 feet. He thought, if it was understood by everybody, there was no objection to any kind of definition, except the objection which applied to any change; but there was the disadvantage of having the same name of "14-candle gas" given to gas of two different qualities. The 14-candle gas under the new mode of testing was not the 14-candle gas under the old Acts, but about 13-candle gas. This had been ascertained by careful experiments, using precisely the same burner and chimney as had always been used for 14-candle gas.

Second Day.—Monday, Feb. 22.

Mr. C. VERNON BOYS.

The first part of to-day's sitting was occupied in the examination of Mr. C. Vernon Boys, another of the Metropolitan Gas Referees, who stated that he agreed with Mr. Vernon Harcourt that the present test for sulphuretted hydrogen was unnecessarily severe. He had no direct evidence to offer as to the evil effects of sulphurous acid, and ultimately sulphuric acid, either upon the binding of books or upon health. While he knew that a room which was stuffy from burning gas seemed more oppressive than one that was lighted by petroleum lamps, and while it was natural to infer that any difference there might be was due to the sulphur, he was not prepared to prove that it was.

Witness said that the questions arising under the head of "14-candle gas" were numerous, difficult, and the subject of much apprehension. The matter naturally divided itself under three headings—namely, (1) reasons for lowering the candle power; (2) definition of 14-candle gas, or of gas of any other candle power; and (3) mode of testing. As to the first point, so large a proportion of gas was burnt now in heating appliances or for cooking purposes, or by means of bunsen burners with incandescent mantles for lighting, and again in gas-engines for power—a proportion which, of course, was unheard of when the Acts with which they were dealing were originally passed—that the relative importance of the luminous-flame light was necessarily very much less than it used to be. He therefore approved of the policy of reducing the illuminating power, provided it was understood what the effect was upon the light of such burners as were used by the public when the power had been reduced. Upon this there had been very considerable misapprehension. For the purpose of satisfying public ignorance and prejudice—which perhaps was a poor reason after all—there might be something to be said for having a uniform illuminating power throughout London.

Mr. William King, referring to the effect of the lower illuminating power, asked witness whether he contended that with a flat-flame burner the deterioration was much more felt than in the case of an argand or incandescent burner. Witness replied that the way the argand burner suffered in the light it gave depended entirely on what one called the illuminating power. If the definition in use up to 1900 was employed—namely, that one had to burn the gas at the rate of 5 cubic feet an hour, and see what light was obtained in the "London" argand, then the "London" argand burner suffered from a fall of illuminating power more than the flat-flame burners did, but not much more. If, on the other hand, one took the "London" argand, and defined the illuminating power of the gas according to the manner which Sir George Livesey got introduced into his Act of 1900, then while the gas remained the same for any particular light below 16 candles, one attributed a higher value on the South Metropolitan definition than was given before; and compared with this, if the same definition was used for 14-candle gas, and not the old definition for 16-candle gas, the flat-flame burners fell off enormously more in the light they provided, with the diminution of candle power, than they would have done under the old definition. Mr. William King: "If you will allow me, I will go into this in a little more detail. You have a certain gas which we all call 14-candle gas, but you make an inferior gas—I do not say that it is 12-candle or 13 candle, but you make an inferior gas. Now, would not the users of flat-flame burners be damnified to a greater extent than those who use the argand or incandescent burners?" Witness: "I cannot give you a definite answer with respect to incandescent burners; but with regard to the argand, you may say that practically nobody does use them. The 'London' argand is used in some city offices occasionally; but for all practical purposes the argand burners, or burners of the same kind, are not used for room lighting in these days, at any rate in London. They are mainly used for testing purposes. I should like to make this explanation. If you take the old definition of a lower gas (I do not care what the gas is), and burn at the rate of 5 cubic feet per hour, then, as I have already said, with that definition of a lower power gas the light given by the 'London' argand and by the flat-flame burners will both fall together—the flat-flame burners a little more than the value attributed to the gas by the 'London' argand. You ought to burn all gas at such a rate as to give the best duty. If you burn 14-candle gas in the 'London' argand at 5 feet an hour, provided that you always burn in the flat-flame burner at the best duty, as the illuminating power of the gas falls the flat-flame burner will suffer more—again, not very much more, but decidedly and definitely more—than the 'London' argand. But if you do what we have to do under the present conditions—that is to say, under Sir George Livesey's arrangement—and burn what Sir George Livesey calls 14-candle gas so as to give a 16-candle light, then (I think this is what you are asking me about) the fall of light by the flat-flame burner will be very much greater than the fall attributed to the gas by the second of those two definitions."

Continuing, witness said that almost any way of defining or speaking of the question was arbitrary and artificial; but he would not say that the way of speaking which was introduced in the South Metropolitan Act of 1900 made it still more arbitrary and artificial. He agreed with the Chairman that the definition under that Act was that 14-candle gas was gas which when burnt in a certain burner so as to give not 14 but 16 candles would have to be consumed at the rate of 5⅔ cubic feet per hour. In answer to the Chairman's query: "In what sense is that 14 candles at all?" witness said: "Well, I think it is a little difficult to defend that definition." He did not regard the fact that flat-flame burners fell off in efficiency so much more with inferior gas in proportion to the "London" argand, as a general argument against the introduction of a gas of lower illuminating power; but he thought it ought to be understood by those who were settling this question what the effect was. His own view was that they should not be too much tied by an official definition which was in its very nature arbitrary. A new question required to be decided on the pure merits of the case, as distinct from arbitrary former definitions which did not apply to the present time. It was not desirable that the Committee should take the artificial definitions by which the Referees had been bound as something that had come down from above and must not be interfered with. It was really much more important to see, in so far as the question of luminous flames had any importance at all (it had some), what effect the reduction of candle power had upon the burners which were actually used by the people—mostly poor people. He would not suggest that in order to carry out this idea the official tests should be made with flat-flame burners. The argand test, as they now had it, was perfectly competent to deal with any gas down to 12 candles. It was not necessary to remove the argand burner from testing because it differed in its results, as they got down to poor gas, from flat-flame burners; but, at any rate, when a question concerning a much poorer gas was under discussion, it was not desirable—in fact, it was mischievous—to base all the arguments and conclusions on what the argand showed. They must be directed in the first instance by the behaviour of the flat-flame burners with the poorer gas. He should imagine that good tests of poor gas could be made with flat-flame burners, though he had not made any experiments. In some Scotch Acts (where they had high candle gas) a flat flame was specified for testing; but he was not quite sure how it behaved with poor gas. He supposed that in the future luminous flames would be still more superseded than they had been by incandescent burners; but he did not think that, so long as the ordinary burner could be used, it would ever be superseded altogether in every place.

Asked whether he had contemplated what the effect would be of the abolition of the whole system of testing, both in respect of illuminating power and of purity, witness said he had purposely not referred to this subject, because he thought that the Referees, as interested parties, should hardly be called upon to argue for the system. Of course, those who had gone into questions of political economy with fulness had a great deal to say upon the effect of monopolies; and if there was a monopoly, it did not follow that the public were served, unless there was some check on the monopoly, as well as they would be if there was free competition. But he thought that upon this point the arguments for and against would better come from the two parties who were interested—the Gas Companies on the one hand, and the consumers on the other—rather than from the Referees, who were impartially placed between them, and who might have a vested or other interest in the continuance of the testing.

Witness went on to say that there was nothing of serious importance in Mr. Vernon Harcourt's evidence with which he disagreed; but there were one or two answers to which he took exception. His own experience of ignorant people in the handling of gas was that they never thought of looking at the size and shape of the flame. What they wanted to do was to turn on all the gas they could. If the flame flared and burnt more gas than it should do, they did not care. They liked to hear the roar of it, which was an indication of plenty, at least. This, of course, did not apply to educated people. Mr. Vernon Harcourt must have been putting his own knowledge and care into the matter, and thinking of people like himself who had to handle gas-taps; but his statement did not apply to the ordinary run of the public. People, when they had a gas-burner put up, instructed a fitter as to the kind of burner they wanted (even if they went as far as this); and then they used it for all it was worth. If it was not satisfactory, they simply said: "I want a little more light," or "I want a bigger flame;" and a different burner was fitted. In answer to a question by Mr. William King as to whether the ordinary consumer would be conscious of a difference of illuminating power of half or three quarters of a candle, witness said the eye was not a photometer at all; and that a person could not remember one day what light he saw the day before. Even if there were two lights in one room, it was very difficult to distinguish their illuminating power by merely looking at them. If anyone was on the border-line between seeing or not seeing what was before him, probably a candle power would make the difference of being able to see or not; but if one was able to see in either case, it would not be possible to distinguish between a 14 and a 16 candle light. Of course, if there was a variation of 4 or 5 candles, it would be a different matter. The effect of a lower candle-power would be, not that people would turn the tap a little more or less, but that burners would be fitted up suited to consume rather more gas, so as to give about the same amount of light. In Liverpool and the North of England, where only gas of a much higher illuminating value was used, people habitually employed smaller burners than was the case in London. Upon this point there was something he ought to say which was in favour of the Gas Companies' position. If a lower-power gas was being burnt, and a burner was being used which consumed a little more gas, though there was a considerable fall in the light given by any particular flat-flame burner, as the illuminating power of the gas fell—though there was this very great fall of light given by the burner—if for the lower candle-power gas a burner was habitually employed which consumed rather more gas, the duty from such a burner on the whole was something more than that of the smaller burner. Therefore, though the larger burner was subject to this same effect, when a change was made from a smaller to a larger burner so as to get the same amount of light again, and burn more gas, a rather better duty was secured from the burner than from the smaller one. But—and he gave this opinion simply for what it was worth—he considered that this was not sufficient in amount to make up for the increased consumption for any given illuminating effect. Still, it was a factor tending in favour of larger burners with lower-power gas. All it did was to mitigate the harm—not cure it.

With regard to water gas, witness said that, when pure, it had a less calorific value than coal gas; but that which was carburetted and used for mixing with coal gas had a calorific value of the same order as coal gas—it was more or less, according to the degree of enrichment. It so happened that the Referees had made during the last year or two some tests on the calorific value of gas. They tested the South Metropolitan gas (which was free from water gas) and that which the Gaslight and Coke Company supplied in Victoria Street (which had some proportion of water gas in it, and therefore an increased proportion of carbonic oxide). Speaking from memory, the South Metropolitan gas was the better by some 5 calories to the cubic foot. The figures, roughly, were about 150 for the South Metropolitan and 145 for the Gaslight and Coke Company. Pure water gas—he supposed it would vary with the way it was made—had a calorific value of about 72, or rather less than half that of pure coal gas or coal gas mixed with carburetted water gas. If coal gas were mixed with plain water gas, the calorific

and illuminating value would both fall very badly indeed. He put this forward because it went some way towards indicating that illuminating power in gas was not pure waste. At the time that the Referees were testing the change of light given by gas which had been scrubbed with a water-spray apparatus, they tested the calorific value also. It did rise and fall with the illuminating power, but not at all in proportion; the change in calorific value was much less in proportion than that in illuminating power. However, all he wished to put before the Committee was that the illuminating power was not wholly waste.

Mr. William King remarked that, inasmuch as witness had stated that, with a lower quality of gas a larger consumption must naturally take place to produce the same light to the consumer, it would really be very largely a question of price. If it was impossible to reduce the price in proportion to the illuminating power, then the higher the quality of the gas the cheaper it would be to the consumer. Witness agreed with this, but thought that it hardly affected the general question. Treating this part of the matter separately, he should say that it certainly did not answer to lower the illuminating power unless the price was reduced in such a proportion as, with the flat-flame burner (which was the burner the public used), would keep the light given for money paid in the same proportion as before.

Referring to the altered method of testing for illuminating power adopted by the Referees, witness said that for all practical purposes the change was insignificant. The old candle test was exceedingly troublesome; and any test might come out, if the candles did not burn well, half a candle wrong. When the examiner made his three tests, there might on some day, if the candles were behaving badly, be an approach to half a candle error. This he had always understood was the object of the provision that there should be no penalty until 15¼ candles was reached—the point being that one could not be sure within the limits of half a candle. Now the Referees had removed this great uncertainty, and replaced the candle test by one which was perhaps five or ten times as precise. They had only, within the limits to which they intended the method to apply, introduced a change which was far smaller in amount than the uncertainties from which they all suffered before. As to the question of chimneys, he thought the Gas Companies attributed more importance to this than it deserved. But they ought to treat the gas fairly, and give it the chimney it liked best—that was, the smaller chimney for the poorer gas. The injury to the gas, however, was extremely small (not more than 1 in 150, or ⅔ per cent.), if the 16-candle gas chimney were taken for the poorer gas. In fact, occasionally, owing to the limit of uncertainty in all photometrical experiments, a single test might show a reversed result. If the same chimney and the same burner were used for the poorer gas as for the other, he did not really think any practical injustice would be done.

There was another point in connection with flat-flame burners which was of some importance as bearing upon the obligations of a company—the pressure at which the gas was supplied. The burners which the South Metropolitan Company arranged to distribute gratis in their district when the illuminating power was reduced to 14 candles were stuffed burners. The main resistance to the flow of gas through the burner was caused by the passage being filled with a porous plug, so that the flow was roughly in accordance with the pressure. Therefore when the pressure changed (as it was bound to be) the effect on the flame was very marked. On the other hand, when some of the old-fashioned burners were used, in which the flow was regulated by the efflux through small orifices, the rate of flow varied roughly with the square root of the pressure. Thus the variation of flow of the gas was very much greater with a stuffed burner than with one in which the rate was determined by the resistance to its issuing at a jet. When, therefore, flat-flame burners were used, it was more desirable that the flow of gas should be controlled by the size of the orifice than by anything of the nature of a porous plug.

Dr. J. S. Haldane.

The second witness examined at this sitting was Dr. J. S. Haldane, who placed before the Committee details of experiments on the effect of the addition of sulphur to gas in the form of carbon disulphide upon the atmosphere of the room in which it was burning. It was, he said, the general impression that air which was much vitiated by combustion of lighting gas was distinctly oppressive, apart from the rise of temperature which was usually associated with the vitiation. The same unpleasantness was not produced by the combustion of a clean lamp burning good paraffin oil.

A perceptible quantity of oxidized sulphur in the air was unpleasant; but he knew of nothing to lead him to suppose that it was actually injurious to health, except in the case of really sensitive people. He had made no special observations on the effects of sulphuric acid on books, &c., though he knew, as a matter of fact, that the sulphuric acid in air—especially in London air—was very destructive. For instance, if one tasted the rust which very rapidly formed on ironwork in the air of a London house, one got the taste of sulphate of iron. The reaction was acid, and the dust all over the room was acid which could only be due to sulphuric acid. But this sulphuric acid was, he thought, mostly due to the general London air, and only partly to the gas. He should attribute most of it to the sulphuric acid present in the outside air from the combustion of coal. He attached great importance to the purity of gas in this respect on the score of comfort, and probably on the score of health for delicate persons. And the lower the illuminating power of gas went, the more important did this matter of the sulphur become, at any rate with flat-flame burners, because, in order to get a certain light, it was necessary to burn more gas. Sulphur impurity which would matter very little in the North and Scotland, with gas of 25 or 26 candle power, would be much more important if the gas were of 11 or 12 candle power, such as it was proposed now by the Crystal Palace Gas Company to distribute in the South of London. Dr. Farquharson asked whether, if there were a large number of lamps burning in a room the discomfort experienced would not be from the removal of the oxygen; but witness said he did not think the removal of the oxygen affected anyone. He could not point to any specific deleterious effect on the constitution from sulphur in the atmosphere from gas. If it affected people at all, it was through the nervous system—through the unpleasant oppressive feeling which it produced. So that, although there was no specific damage, there might be some indirect damage done to persons of some constitutions. It was of the nature of the damage done by a bad smell—it was reflex. It was through the nervous system, not through the absorption of any poison. Fatal gas poisoning was always by carbon monoxide, except in the case of crude coal gas, where there was enough sulphuretted hydrogen to kill very rapidly. Sulphurous acid in large quantities as a disinfectant was still for some purposes extremely useful. When employed in its most effective form as a disinfectant, there was about (say) 15 per cent. of sulphur dioxide, whereas 0·06 per cent. would kill a man or an animal; so that a much larger quantity was required to kill a germ than a human being. Dr. Farquharson: "Is it the sulphurous acid or the carbon dioxide that produces the uncomfortable feeling you have described?" Witness: "I think certainly the sulphurous and sulphuric acid; I think there is a mixture of the two."

Questioned by Mr. William King as to whether it would be fair to compare the effect of gas and oil-lamps on the air of rooms if in one case the light was very much less than in the other, witness said he thought it would be sounder to compare the effects of the products of combustion for an equal illumination. This he had never done; he had only taken the carbonic acid as a measure of the purity of the air in comparing lamps and coal gas. If the calculation were based on an equal amount of illumination, he felt sure the results would come out not very much different. Another point was that in actual practice a paraffin oil lamp very often smelt; and his remarks only applied to a very well kept lamp, such as perhaps was not often met with in practice. He would not like to argue from the point of view of purity of the air that an average paraffin oil lamp was preferable to an average gas-jet. One always knew the evils of the gas jet; whereas the evils of the paraffin lamp might be terrible when they did appear. With the general use of incandescent system, of course, there was a great reduction in the consumption of gas; and with these burners even an increased amount of sulphur compounds other than sulphuretted hydrogen would have a dimished effect for a given illumination. He had not made any tests himself; but he believed that there was a very small amount of sulphur compounds in carburetted water gas. The sulphur could be reduced to a minimum by the simple means of oxide purification—in other words, it was almost entirely in the form of sulphuretted hydrogen. Therefore, as he understood it, the use of carburetted water gas would tend to reduce the sulphur compounds very considerably, and so from this point of view would be advantageous.

Witness was next invited by the Chairman to give the Committee any views he might entertain as to the use of water gas regarded from the point of view of carbonic oxide poisoning; and he replied that he looked upon undiluted carburetted water gas—that was, undiluted with coal gas—as a very dangerous thing to distribute. This had been proved in America. It occurred frequently—not very seldom, he should say—that an ordinary jet was left turned on at night; and if the gas was carburetted water gas, the chances were that the person in the room would be dead in the morning, whereas with ordinary coal gas the chances were very much against it. There was, he should say, on the average about 7 per cent. of carbonic oxide in coal gas, and about 30 per cent. (or four times as much) in carburetted water gas. Nevertheless carburetted water gas was much more than four times as dangerous as coal gas. It happened that with ordinary average ventilation through the walls of a closed room one reached the poisonous limit with the water gas; but it was very seldom one did so with ordinary coal gas or any gas containing a moderate percentage of water gas. He should therefore certainly be inclined to limit the amount of water gas that might be mixed with coal gas; but to say where the limit should be was very difficult. Experience in England pretty well showed that the admixture of a moderate amount of carburetted water gas was a very slight source of danger to the public. It no doubt must make the gas a little more poisonous; but it did not seem to make it materially more dangerons. The limit would depend upon the total proportion of carbonic oxide from whatever source arising. A mixture with 50 per cent. of carburetted water gas, for instance, was nothing like half so dangerous as pure carburetted water gas. The poisonous action of carbonic oxide was insidious, particularly because it did not or might not wake people up in the night.

Dealing with the same subject, Mr. William King said: "Suppose it could be shown that a mixture containing 50 per cent. of carburetted water gas had been supplied to a population of 62,000 people, by day and night during the whole twenty-four hours, for seven years and a half, without any casualty or inconvenience, would not that be a practical proof of the safety and practical convenience of distributing the mixture?" Witness: "Well, I should consider it valuable evidence on the subject; but I do not think it would prove more than it actually does prove. A population of 60,000 is not a very large population." Mr. William King: "Take, for instance, Cheltenham. I think the population there is about 55,000. It would be at all events, you would say, a very fair-sized town?" Witness: "Yes; I think it would be very valuable evidence. But I should not like, for instance, to repeat the experiment on the whole of London." Something like this, he added, had already been done at Tottenham; but there they had had casualties. Fatalities with coal gas did of course occur; but the danger of poisoning in this way was almost microscopic. Certainly, in the case of a fractured main a whole house might be flooded with gas, and people might be killed by scores. Water gas of high illuminating power had a great deal to be said for it, as an admixture with coal gas and as a means of getting rid of sulphur compounds in an easy way.

In answer to the Chairman, witness said he agreed with Mr. Vernon Harcourt and Mr. Boys that the present stringency of the test for sulphuretted hydrogen might be relaxed. Sulphur impurity in the form of sulphuretted hydrogen would be worse for the fittings than in any other form; so that it would be necessary to maintain a distinct test for the sulphuretted hydrogen, and not merely to take a test for the whole sulphur. The test for sulphuretted hydrogen might be arranged in very much the same way as Mr. Vernon Harcourt's ordinary sulphur test. Carbonic oxide killed by suffocation—by cutting off the supply of oxygen. It possessed anæsthetic properties, something

like nitrous oxide. A person who happened to be overcome by it but recovered, as a rule suffered no permanent effect, unless it occurred within the next day or two, though it did occasionally happen that if a person had undergone some great exertion while under the influence of the gas—say, in a coal mine—injury to the heart resulted. He should say that gas which, under the test for sulphuretted hydrogen prescribed in the Gas-Works Clauses Act of 1871, showed no sign whatever on the lead paper, was for all practical purposes absolutely satisfactory so far as the sulphuretted hydrogen was concerned. Of course, the moist lead paper was a severer test in itself than dry lead paper, which was prescribed by the Referees.

Third Day.—Tuesday, Feb. 23.

Mr. T. SEAGER BERRY.

A history of the subject under consideration was submitted by Mr. T. Seager Berry, the Parliamentary Officer of the London County Council. Witness said the Council regarded the different candle power gases supplied in the Metropolis as an inconvenience. Whatever their views might be on the standard of illuminating power, they thought that a different standard for different Companies was worse even than having the power lowered to 14 candles.

As to appeals to the Chief Gas Examiner, the Council found themselves in a difficulty. The Companies were allowed to appeal within seven days after the report of the Gas Examiner was delivered to them; but the Act stated that the report of the Chief Gas Examiner on appeal, or the report of a Gas Examiner after the period for appeal had elapsed, should be proved before a Magistrate "at any time within one month after the date of the report," for a distress warrant to be issued. The trouble was this: One of the Companies was reported by the Gas Examiner for defective illuminating power. The Company appealed to the Chief Gas Examiner, and let the appeal lie for a month, when they withdrew it. The Council then took proceedings, which were unsuccessful; the High Court upholding the argument of the Company that there had been no "decision" by the Chief Gas Examiner, that all the Council could rely upon was the report of the ordinary Gas Examiner, and that as consequently they must proceed within a month of this report they were out of time. The Council were, therefore, now in the difficulty that there was nothing to prevent a Company appealing and subsequently withdrawing their appeal. It was often impracticable for the appeal to be dealt with within a month of its being lodged; and in these circumstances the Council could not proceed to recover the forfeiture. A Bill (copy of which he handed in) had therefore been promoted to deal partly with this. It also dealt with a difficulty which arose over a strict reading of the provision that the Chief Gas Examiner's decision "after hearing the parties" should be final and conclusive. There was no method which enabled the Chief Gas Examiner to compel parties to come before him; and apparently, on the strict wording of the section referred to, he was debarred from giving a decision if he had not heard them. The Council proposed to cure this by allowing the Chief Gas Examiner to give a decision (clause 3) "without hearing any party who shall fail or neglect to attend before him after receiving not less than seven days' notice of the time and place fixed by the Chief Gas Examiner for hearing any appeal under this section." Clause 5 of the Bill was practically a reproduction of section 18 of the Gaslight and Coke Company and Other Gas Companies Acts Amendment Act, 1880, but omitting the words "on proof of any such report before a Magistrate at any time within a month after the date of the report." The effect of this, as the Council understood it, would be to eliminate the difficulty which arose owing to their having to proceed before a Magistrate within a month. Clause 6 of the Bill dealt with the time within which the proceedings must be taken; and they made it six months "after the date of the report of the Gas Examiner or after the date of the report of the Chief Gas Examiner on appeal, or, in the event of the Company appealing to the Chief Gas Examiner and withdrawing the appeal, within six months from the date of the receipt of notice of such withdrawal." Witness agreed with a suggestion of the Chairman, that unless the Companies objected, it might be convenient that the Company concerned should send notice of appeal to the County Council as well as to the Chief Gas Examiner. It might also be useful to put a clause in some Bill to say that in Police Court proceedings the report of the Chief Gas Examiner should, unless the contrary was proved, when produced by the controlling authority, be accepted as his report. It might cause considerable inconvenience if the Chief Gas Examiner had to attend the Court and prove his certificate, or send someone who could prove his signature to the report. As a matter of fact, as far as these reports had gone, no one had ever seriously disputed them.

The Chairman said there was one other matter relating to these appeals to which he would like to refer. This was the ambiguity of the Act as to the form in which the Chief Gas Examiner had to make a decision. The words used were: "If the Company think themselves aggrieved by any report of the Gas Examiner, they may within seven days after the day on which that report is delivered to the Company, appeal to the Chief Gas Examiner, whose decision after hearing the parties shall be final and conclusive." The question he wished to raise was, "Decision" as to what? He thought the practice of his predecessor in the office of Chief Gas Examiner was to give a decision as to whether the original reports should stand or be cancelled; but this form of decision was not always very appropriate. Supposing, as recently happened, the arithmetic in a report was incorrect, had he, when appealed to, to cancel the report on this ground, or had he to amend it, and hold that, as amended, it should stand? Witness suggested that words giving power to "vary, modify, cancel, or confirm" would be better; and the Chairman said he thought they would meet the difficulty, as it seemed to him that the title "Chief Gas Examiner" rather hinted that the duty of the holder was more to revise a report than say whether it was formal or informal. Witness remarked that this was a matter the Council would be very glad to consider in connection with any Bill they might have dealing with this question.

Witness said he thought there ought to be some simpler provision than now existed for enforcing the notification of the Referees. In 1900, the Referees altered their notification, and required each testing-place to be directly connected with the main or mains specified; but the matter was still pending. It was a very troublesome proceeding to make a Company comply with the notification. He also explained the difficulty that had arisen over the testing of gas on Sundays. As to illuminating power, purity, price, and method of and apparatus for testing, until 1900 (with the exception of the portable photometer proposal, which was a 1900 Bill), no suggestions for alterations had been made by the Council. They had all emanated from the Companies; and therefore the Council, until they had before them the suggestions on those subjects which the Companies might desire to place before the Committee, were not in a position to deal satisfactorily with such points. Witness next described the powers of the County Council over the Gas Companies; and he then went on to express the opinion that when Parliament sanctioned the proposal to alter the method of testing which was introduced in the South Metropolitan Company's Bill of 1900, they hardly appreciated what they were doing. The Council always had a doubt as to what Parliament meant by "14-candle power gas." Their view had been that, as often happened, being an uncontested clause, it passed without anybody on the Committee side of the table very much appreciating what it meant. The Council would not, so far as he was advised, be disposed to accept the view that with regard to testing the Companies might very well be left to themselves, that they would find it to their own interests to provide gas of a suitable illuminating power and purity, and that they might be trusted to do this without any control by another authority. The Council thought that there ought to be control in testing.

WIDNES CORPORATION GAS SUPPLY.

Large Profits on Cheap Gas.

At the Meeting of the Widnes Town Council on Tuesday—the MAYOR (Alderman S. Quinn) in the chair—the accounts of the gas and water undertakings were submitted through the medium of the Finance Committee. The gas revenue accounts showed that the profit for the year ending the 31st of March last had been £6254, and on water-works account £1443; but from the gas-works profit the sum of £1637 must be deducted for the amount charged for public lighting during the year, and from the water-works profit £271, the net cost of the Fire Brigade Department for this period.

Alderman TIMMIS, in moving the adoption of the minutes of the Gas and Water Committee, mentioned the amount of the profits, and pointed out that gas had been made at a net cost of 5·4d. per 1000 cubic feet, or with the cost of distribution 7·18d., and after paying all sinking fund charges, &c., at a cost of 11·17d. The profit was at the rate of 5·45d. per 1000 cubic feet. He explained that the purifying plant had been extended at a cost of 5s. per cubic foot capacity in the purifiers, which anyone understanding the cost of erecting works would know was very low. The quantity of gas supplied was 288½ million cubic feet—an increase of 7·8 per cent. on the previous year. The Committee had decided to raise the wages of all the stokers at the gas-works by 3d. per shift; bringing up the average wage of 35s. to 36s. 9d. weekly. This would cost an extra £200 a year, and was made on the recommendation of the Engineer (Mr. Isaac Carr). The increase would improve the workmen's services, and would induce men of a better class to apply, and to value their good jobs at a time when these were not very easy to pick up. The quantity of water supplied was 1033½ million gallons - an increase of 5 per cent. on the year 1902-3; and it was the largest consumption on record. An extension of the pumping plant had been sanctioned which would bring the capacity up to 118 million gallons per diem. The great feature of this lay in the fact that the consumption of water in Widnes was very largely in excess of other towns, being 80 gallons per head per day; but with the extension they would be able to supply 100 gallons per head if necessary.

Mr. SMITH seconded the motion; and it was carried.

Mr. OWENS, the Chairman of the Finance Committee, also congratulated the Gas and Water Committee and the Engineer upon the results achieved, and pointed out that his Committee had resolved that the amounts of £6254 on gas-works account and £1443 on water-works account be appropriated as follows: Gas—To public lighting, £1637; to expenditure on capital account, £3150; to depreciation fund, £500; balance, £967. Water—To Fire Brigade, £271; expenditure on capital account, £52; to depreciation fund, £500; balance, £620.

RAMSGATE GAS AND WATER SUPPLY.

The Gas and Water Committee of the Ramsgate Corporation held a meeting on Monday evening last week, when a report was submitted on the working of the gas and water undertakings in the financial year ending the 31st of March.

Mr. GWYN, in moving the adoption of the report, dealt first with the capital account of the gas undertaking, and remarked that there had been no unusual expenditure, with the exception of the cost incurred in connection with the new loans. Turning to the revenue account, he said it included some interesting and satisfactory features. The cost of coals was £28 13s. 3d. in excess of the previous year; purifying materials, &c., cost £92 less; salaries, £35 less; and wages, £310 less—highly satisfactory figures, considering that there had been handled 286 tons more coal, and that 8,096,000 feet more gas was produced, the increase being equal to 3·44 per cent. The repair and maintenance of works was a considerably higher figure for very special reasons. The total was £1607, of which £1000 was on account of the new retort-bench. This was an instalment in reduction of the £3250 expended during the year in partly rebuilding the bench; and the remaining half of the work would be completed during the current year. Under the heading of distribution, the charges amounted to £74 more—an item of £182 11s. 7d. figuring as the cost of repairing and renewing prepayment fittings. The revenue from the sale of gas showed an

increase of £1083. Residuals had produced £1677 more; coke having contributed £1075, tar £102, and sulphate of ammonia the important sum of £500. The statement as to the sale of residual products showed that 52 tons of sulphate in excess of the preceding year had been made, giving a total production equal to 21·84 lbs. per ton of coal carbonized. The coke made for sale had been 10·85 cwt. per ton of coal, against 10·38 cwt. before; while the quantity of gas made had increased from 11,076 to 11,304 cubic feet. It was the gratifying figures on this side of the account which had contributed principally to the substantial balance carried to profit and loss; being £9428, or £1628 in excess of the year 1902-3. It was well this was so, for on coming to this account they would find that amount was quite necessary to meet the increased capital charges. The balance remaining as net profit after providing for these was £1006 13s. 7d.; the figures last year standing at £1098 15s. 6d. As to the water undertaking, the amount expended on capital account during the year was £499; being £1078 less than in 1902-3. The receipts showed a diminished sum of £81 received for the sale of water. This item was made up of decreased meter consumption £35 (due to the wet season) and an increase in the empty houses of £46. The other amounts were about the same. The gross profit came out at £6474; and the net profit was £500. The Chairman made further allusions to some of the most satisfactory features of the report. He said he wished to congratulate the Engineer and Manager (Mr. T. N. Ritson) upon a very successful year's working, and was sure all present would desire to associate themselves with his congratulations.

Mr. HACKER seconded the motion.

The MAYOR (Mr. R. Dowling) also offered congratulations both to the Chairman and the Engineer. He thought every credit was due to Mr. Ritson, who had carried out his important duties in a most careful manner, and had devoted an immense amount of energy and ability to the work. No praise they could offer to him could be too high.

The report having been adopted,

Mr. RITSON expressed his appreciation of the kind remarks of the Mayor, Chairman, and members, and said they might rely upon it that there should be nothing wanting on his part to make the gas and water undertakings successful in the future.

MANAGEMENT OF THE TIVERTON GAS-WORKS.

The Tiverton Town Council had under consideration last week a report by the Lighting Committee on the subject of the management of the undertaking. The Committee had had an interview with the Manager of the Yeovil Gas-Works (Mr. E. Howell) who made certain recommendations; but it was decided to defer dealing with these until the advice of the new Manager was obtained. In consequence of the publicity given to the proceedings of the last meeting of the Council, several managers of gas-works had applied for the position of Manager; and the Committee recommended the appointment of Mr. Clarke Jeffery, the Manager of the Ware Gas-Works, at a salary of £185 a year. Several members of the Council opposed the confirmation of this recommendation, on the grounds that the vacancy should have been advertised, and that a Manager might have been obtained for a smaller salary. Another objection was that, in view of the probable erection of electric light plant, a man should have been obtained who was conversant with the management of electrical as well as gas works. It transpired that the Lighting Committee comprised the whole of the members of the Council, and that the selection of Mr. Jeffery was made by a large majority. It was now confirmed by 15 votes to 6. Mr. Watkins expressed the opinion that they had made a wise selection, and that in the new Manager they would have a man possessing skill and experience. As to the salary, it was only about £10 more than Mr. Jeffery had been receiving at Ware. With regard to two stokers dismissed at the last meeting, it was stated that it had been decided not to reinstate them, but other work had been found for them. The annual statement of the working of the gas undertaking was submitted to the meeting. This showed that for the year ended the 31st of March last there was a gross profit of £1949, and that after payment of interest and sinking fund amounting to £1774, there remained a balance of £175, which was carried to the reserve fund. The balance standing to the credit of the reserve fund was thus raised to £2748; and there was also £7029 in the sinking fund. An increase had taken place in the demand for gas for cooking and heating purposes. The consumption under this head was 4,049,800 cubic feet—an increase of 24,200 cubic feet; while the number of stoves on hire had been increased during the year from 341 to 388.

The Geltsdale Water Scheme at Carlisle.—The Committee of the Carlisle Corporation who have been considering the Geltsdale gravitation water scheme, have decided to recommend the Town Council to accept the tender of Messrs. William Kennedy and Co., of Partick, Glasgow, to carry out the work, other than the construction of the large reservoir at Castlecarrock, for the sum of £120,377. There were nine tenders. The estimated cost of the reservoir, which is excluded from the tender, is £71,000, and of lands, &c., £35,000; making a probable total outlay of £225,000.

Incandescent Gas Lighting at Bethnal Green.—The Works Committee of the Bethnal Green Borough Council reported on Wednesday that they had had under consideration a letter from the Commercial Gas Company containing an offer to convert the existing lamps into No. 4 Kern incandescent burners, charging the same amount for gas for the next eighteen months, when the price would be reduced to £2 18s. In a further communication, the Company stated that they were prepared to alter the lamps and fix new burners at a cost of 16s. each; the price for gas and maintenance to be reduced as soon as the lamps were converted. There were 110 lamps which required conversion; and the Committee decided for these to be dealt with under the last-named arrangement, at a cost of £88.

MALTA AND MEDITERRANEAN GAS COMPANY, LIMITED.

The Ordinary General Meeting of this Company was held last Tuesday, at the London Offices, 60, Gracechurch Street, E.C.—Colonel JAMES LE GEYT DANIELL in the chair.

The SECRETARY (Mr. A. W. Cooper) read the notice convening the meeting. The Directors' report and the accounts were taken as read.

The CHAIRMAN said he hoped the results of the operations of the Company during the year ended March 31 last would commend themselves to the general body of the shareholders, as they did to the Directors. The report informed them that, since their last meeting, Mr. Basil Thomas Makins (who, from ill-health, had not been able to attend to his duties as a Director so much as he could wish) had sent in his resignation, which was regretfully accepted; and the report further told them of the appointment, in the interests of the Company, of two other Directors—Mr. A. F. Phillips and Mr. A. W. Oke. In making a general review of the accounts, he said the shareholders would have observed that, under the head of coal, oil, and coke, the expenditure was £9334, which compared favourably with the preceding year—being a decrease in cost of £716; and this was accompanied by an increase in receipts for gas of £1128, or 4·28 per cent. The quantity of gas sold was 112,155,000 cubic feet, as against 106,392,000 cubic feet, which was an increase of 10·54 per cent. It should be remembered that the year with which this comparison was made was a most favourable one, showing, as it did, a material increase over the year preceding it. The next item on the debit side of the profit and loss account which had no doubt attracted the attention of the shareholders was the cost of maintenance, which had increased by £1794; but they would see the reason when he explained that this item bore the cost of laying a new main, and of enlarging and laying other mains, at Malta—in fact, he believed that Malta was entirely responsible for the increase. The item of "inspection of stations" was a small one; but it was accounted for by a visit of inspection by their friend Mr. Phillips to Malta and the Sicilian stations, as well as by one of their officers. The Directors thought it was a wise thing that he should make a visit of this kind periodically. The increase in the legal expenses was in consequence of the employment of a legal adviser (Signor Pierantoni, of Rome), in connection with the Trapani debt; a debt which had caused the Directors considerable anxiety, but which, he was happy to report, had now been paid off—that was to say, it had been paid off up to last September. He (the Chairman) had already touched upon the increase in the amount of gas sold. Coke had not shared the same good fortune as gas; for the sales showed a decrease of some £396, although 357 tons more had been sold, but the price had been against them. Tar and pitch exhibited an increase of £151; and fittings and meters also figured at an increase of £216. He now came to dividends on investments. These had altogether disappeared from the profit and loss account, and were included under another item in the general balance-sheet, to which he would presently draw attention. Coming to the general revenue account, on the debit side the interest on debentures was less, because, in the course of the year, the Directors had reduced the debenture debt by £1700, which they had paid off. They had also carried £1700 to an amortizement account; and it appeared under that name for the first time in these accounts. He might explain that they formerly had two accounts—the reserve account, with £5500 to its credit, and the reserve fund account, with £5951, represented by investments, which (after writing off the depreciation) stood, in the previous year's account, at £10,905. They stood at the same figure in the present accounts. The amortizement account was the outcome of a conference between the Directors and the Auditors, when it was decided to transfer the two reserve accounts just mentioned to an amortizement account, and to carry the dividends on investments to the amortizement account instead of to the profit and loss account, as well as any contributions from the general revenue account which that account could afford annually. Turning to the amortizement account, it would be seen that it now stood at £13,479. The object for which this account was created spoke for itself. It would be remembered that last year, when he was referring to the contracts for lighting the Sicilian stations, he stated that they might not go on for ever; and the Directors wished to be prepared for anything that might occur if the contracts could not be renewed. He might say that it was very agreeable to the Board to meet the Auditors; and he thought that sometimes conferences of this kind would be attended with good results to the Company. When, for instance, the Auditors had any suggestions to make for the improvement of the form of the accounts, the Directors would always be found ready to consider such matters. Having gone through the general account, the shareholders would perhaps like to hear what he had to say about the separate stations. From Malta, he could report nothing but good; and Malta was, as they knew, their mainstay. The quantity of gas manufactured there showed an increase of 9·per cent.; and the sales had risen by 8·11 per cent. The advance in the consumption during the last two years had been 26·13 per cent. The quantity of gas produced per ton of coal carbonized was 11,284 cubic feet. Dividing the sale of gas under the different heads, he found that in private consumption there was an increase of 7·54 per cent.; in the naval establishments, 8·36 per cent.; in the military establishments, 11·22 per cent.; and to the Malta Government 10·32 per cent. He drew particular attention to the naval establishments, because the authorities had for some time intended to have, and were now carrying out, their own electric lighting works; and they were proposing to do everything in future by electricity. These works would be ready in about eighteen months or two years' time; but their General Manager (Mr. Starkey) assured the Directors that he thought before that time the Company would more than make up any loss in this direction by the increase in sales in other ways, so great was the demand for gas now. This was rather a strong prediction. But they seldom found Mr. Starkey wrong in his estimates; and he (the Chairman) hoped they would find him perfectly right this time. The Directors entertained the very highest opinion of their General Manager; and also of Mr. Wilson, the Engineer at the works, and Mr. Reid, the District

Superintendent. They were all most active in looking after the interests of the Company, as the shareholders would see by the results laid before them—results which he (the Chairman) trusted would continue. With regard to Trapani and Marsala, nothing of any consequence had taken place there. The Directors would like to see the Marsala contract renewed; and, when the proper time arrived, they would take steps for bringing about the renewal if they possibly could. The Chairman concluded by moving the adoption of the report and accounts.

Mr. STEPHENSON R. CLARKE seconded the motion, which was unanimously carried.

Proposed by the CHAIRMAN, and seconded by Mr. CLARKE, dividends at the rate of 7 per cent. per annum on the first preference shares, of 7½ per cent. on the second preference shares, and of 5 per cent. on the ordinary shares (deducting payments already made on account) were declared.

Mr. A. M. PADDON moved the re-election to the Board of Colonel Daniell. Remarking upon the devotion of the Chairman to the Company, he said that, some three years ago, the affairs of the Company were rather more complex and difficult than now; and he (Mr. Paddon) could assure the shareholders that Colonel Daniell's services were then invaluable to the Company. Matters were a great deal better now; and he hoped the Chairman might for a long time continue to share in the improved circumstances.

Mr. CLARKE seconded the motion; and it was unanimously agreed to.

The CHAIRMAN having responded,

Mr. JOSEPH CASH proposed that Mr. R. Hesketh Jones and Mr. T. Guyatt be re-elected Auditors of the Company. He congratulated the Auditors upon the altered statement of accounts. It put their financial matters almost in a nutshell; and they were now readily understood. Before, there were certain little complex deductions to be made; but now they would be able to see year by year exactly how things stood without much difficulty.

Mr. WESTBROOK seconded the proposition, which was unanimously carried.

Mr. GUYATT, in his acknowledgment, remarked that alterations were not always improvements; but he thought it would be generally admitted that the alterations made in their accounts did improve and simplify them.

The CHAIRMAN moved a hearty vote of thanks to the Secretary (Mr. Cooper), the General Manager (Mr. Starkey), and the other officers.

Mr. A. F. PHILLIPS seconded the proposal, because he knew, as the result of his personal inspection, of the excellent work the whole of the officers and staffs were doing, and could testify to their devotion to the interests of the shareholders.

The SECRETARY having responded,

On the motion of Mr. F. R. SMITH, seconded by Mr. T. WILKINS, the Directors were heartily thanked for their services.

The reply of the CHAIRMAN terminated the proceedings.

DUNDEE GAS AND ELECTRICITY SUPPLY.

Reduction in the Price of Gas.

The Annual Statutory Meeting of the Dundee Town Council, as the Gas Commissioners, was held last Wednesday—Lord PROVOST BARRIE presiding. The business before the meeting was the consideration of the annual accounts and estimates.

Mr. RITCHIE, Treasurer of the City, submitted these. He said that the estimated revenue for the past year in the Gas Department, was £113,290; the actual had been £114,853, showing a surplus over the estimate of £1563. The increase was largely due to the extra sale of coke—£1403 over the estimate. The estimated expenditure was £113,290; the actual had been £113,916—an increase of £626. The quantity of gas delivered was 697,580,000 cubic feet; being about 2½ million feet under the estimate. The estimated revenue in the Electricity Department, including a balance from the previous year, was £27,222; the actual was £27,439—an increase of £217 over the estimate. The estimated expenditure, including the surplus, was £27,222; the actual £27,415—an increase of £193 leaving a balance of £24. There had been generated 2,868,566 units, as against a total output in the previous year of 2,609,718 units. The coal bill was less by £485, and the current generated was 263,000 units more than in the previous year. For the current year, the revenue in the Gas Department was estimated at £106,300, and the expenditure at £105,101; showing a surplus of £1199. The figures now submitted proved the gas account to be in a very satisfactory state. He proposed that the price be reduced by 2d per 1000 cubic feet—from 3s. to 2s. 10d., less 5 per cent.; provision for this having been made in the estimates. They were able to make this reduction because of the purchase of coal at a lower price, along with the reduction of other charges, brought about by the many improvements in the plant. The works would soon be in a position to deal with any demand that might be made upon them, to their maximum production. They were anxious to increase the consumption of gas as far as possible during the day, by fostering its use for cooking, heating, and motive power. The efforts put forth in the past to encourage this class of business were beginning to bear fruit; and they trusted that the consumption would be further fostered and developed. Last year, they offered lower terms to users of gas for power, so as to encourage and develop its use among this class of consumers. He was told that the price of gas at 2s. 7d. per 1000 cubic feet, less 5 per cent., would compare in many cases favourably as against steam. Power might be obtained at this price, by the medium of a modern gas-engine, at less than ½d. per horse-power per hour. They were now benefiting from the large expenditure on the gas-works by the lessened cost of production. Other parts of the plant required consideration, such as meters and main and service pipes; and due provision had been made for these in this year's estimates. The introduction of carburetted water gas would naturally effect some change in the ordinary routine of manufacture, which they trusted would tend towards economy. The sinking fund, charged against revenue, now amounted to over £10,000 per annum; being fully 2½ per cent. on the present amount of debt. The market for residual products was in a very depressed state. The value of tar and sulphate of ammonia was considerably less than that ruling at the beginning of the last financial year. The present rate, for tar alone, entailed a loss of over £1100, taking the average price for the twelve months; and if compared with the price at the beginning of the last financial year, it would show a still greater loss—viz., £2500. The price of sulphate of ammonia was down by £1 per ton, which meant a lessened income of £700. He was glad to say they had been able to develop the coke market to their advantage. The estimated revenue in the Electricity Department, including the balance from last year, was £27,588, and the expenditure £27,420; leaving an estimated surplus of £168. He proposed that the price of electric current, to ordinary consumers, should be—for any amount up to 20 units, 6s. 8d.; per unit above 20, 4d.; for 10,000 units and over, 3d. per unit; and for motive power, for 40 units or under, per quarter, 6s. 8d., and above 40 units per quarter, 2d. per unit.

Mr. G. STEVENSON, in seconding, expressed the hope that the unaccounted for gas might by-and-bye be lessened.

Mr. BROWNLEE had nothing of a critical nature to say about the accounts, except that he thought they were being made to pay too high a price for gas this year. The Treasurer had hidden away £6000, which had been charged against revenue, whereas it ought to have been charged against capital. They were not getting gas as cheap as it was before; and until the price was 2s. 7½d., the consumer would not be so well off as he was prior to the changes being made. While there was a reduction in the rate per 1000 cubic feet, they had to take into account that they were getting one-sixth less value.

Mr. URQUHART called attention to the item of the sinking fund, of £13,402, said to be unapplied. He held that it had been applied, and applied illegally. It had been applied practically in extinction of an overdraft. Their unexhausted borrowing powers amounted to £38,675; and why should not this be exercised to the extent of putting the gas undertaking in the position of having a working capital? It seemed to him that the only one who obtained benefit from this mode of financing was the Clydesdale Bank. Practically they were working the undertaking on an overdraft of £10,000, more or less, during the whole of the past year.

Mr. SPEED congratulated the Treasurer on his statement regarding the gas; but hoped that the better lighting of the streets would be considered.

Treasurer RITCHIE, replying to the discussion, said that gas was cheaper now than it had ever been in Dundee. He did not think they should entertain the proposal to increase the candle power. Even Mr. Brownlee spoke, in an election speech, about the fine light which could be got from incandescent burners. Mr. Urquhart was entirely wrong. They could only use the sinking fund to buy up annuities and to pay off debt. Not a penny paid into the bank for sinking fund could be touched.

Mr. URQUHART said he was perfectly aware of that; but they were getting an overdraft on the security of the sinking fund.

Treasurer RITCHIE replied that there was an equalizing account; and it was to their credit that they got that. He denied that they were systematically overdrawn. They did not need to exercise their borrowing powers—they could get temporary loans whenever they required them.

The Treasurer's motion was then adopted; and, on the motion of Lord Provost Barrie, he was thanked for his services.

CHEAPER GAS FOR ULVERSTON.

A lengthy discussion took place at the last meeting of the Ulverston Urban District Council on a recommendation of the Gas Committee that, as from the 1st prox., the price of gas should be reduced 3d. per 1000 cubic feet, making the figure 2s. 8d., less discount—or practically 2s. 7d. per 1000 cubic feet net. In moving the adoption of the proposal, Mr. Sadler said he thought the Council would see that the Committee were trying to return some of the good to the gas consumer which the consumer gave to the gas-works. Referring to the management, he remarked that he was quite sure there were no works better looked after than were those at Ulverston by Mr. John Swan. Mr. Holmes, in seconding the resolution, said that personally he would have preferred a larger reduction; but at the same time he recognized the wisdom of adopting a cautious policy, so as not to take steps which might subsequently have to be retraced. The contention that instead of reducing the price, they should make a larger contribution in relief of the rates, might commend itself to a certain class who did not toil or spin; but he did not think it was fair to expend the money of the gas consumers in benefiting this class. The reduction of 3d. per 1000 cubic feet would mean a decrease in the revenue of about £500; but this would be compensated for by the gain on the coal contracts and in other ways, and they would probably still have the very handsome profit of over £800. They could therefore continue to make a grant of £300 to the rates, and yet have a balance in hand for purchasing any minor plant required. If they had reduced the price of gas in days gone by, they would no doubt have retained consumers they had now lost; for in these times of competition in regard to power and illumination, they recognized that by lowering the price they would have a larger output. The large consumers found an advocate in Mr. Birkett, who urged that those who took a big supply of gas should have some additional concession made to them; while Mr. Dilworth said that the ratepayers were to some extent the capitalists of the works, and were therefore entitled to substantial consideration. Several of the members complimented the Committee on the results achieved; and Mr. Sadler, replying to the discussion, said they were anxious to build up a large reserve fund, which was an important factor in an industry like theirs, where the wear and tear was so great.

A GOOD YEAR AT MARKET HARBOROUGH.

The annual report of the Gas Manager (Mr. A. J. Harris), which was submitted to the last meeting of the Market Harborough Urban District Council, stated that the expenditure on revenue account for the year ending March 31 was £5432, as against £5322 in the previous twelve months; and the net receipts £8296, as compared with £7695—leaving a gross profit of £2864, or an increase of £492. Interest on loans (£1400), repayment of principal (£701), and proportion of the parliamentary costs incurred in the acquisition of the undertaking (£179), absorbed £2280, leaving a net profit of £584, as against £118, or an increase of £466. The quantity of gas made during the year was 42,640,000 cubic feet, or an increase of 1,830,000 feet. The increase in consumption by consumers' meters was 2,257,800 cubic feet, of which quantity 546,800 cubic feet was accounted for by the extended use of prepayment meters. The unaccounted-for gas was 6·96 per cent., as compared with 7·98. The net receipts from private consumers, after deducting discounts, were £5532, as against £5276, or an increase of £256, notwithstanding an addition of £144 in the discounts allowed, in consequence of their being raised from 2d. to 3d. per 1000 cubic feet, and also special rebates being made for power purposes. The number of ordinary meters in use on March 31 was 694, or an increase of 20; and of prepayment meters, 203, or an increase of 56. During the year, 66 additional cookers were fixed, making a total of 294 now on hire. The receipts from residuals amounted to £1961, as compared with £1624 in the previous year. The net returns from this source equalled 87·69 per cent. of the cost of coal; being 11·6 per cent. higher than in any previous year.

The Chairman of the Gas Committee (Mr. Gardiner) said that the past year had been a record one in every respect; more gas having been made and sold, better working results obtained, higher prices realized for residuals, and consequently more profits made. The gross profit of £2864 was equal to 5·82 per cent. on the capital invested; although the latter was abnormally high compared with the make and sale of gas. After payment of all charges, the surplus profit amounted, as stated, to £584. During the five years that the works had been in the possession of the Council, the output of gas had increased by 29 per cent.; while the number of consumers had increased from 509 to 897. The Committee recommended that a sum of £100 be paid by the department out of the gas profits to the district fund, for the purpose of being expended in extending the incandescent system of public lighting; and that in future no charge should be made to consumers for fixing new incandescent burners supplied by the department. Mr. Gardiner pointed out that this £100 represented the first payment made in relief of the rates; and in stipulating that the money should be expended in extending the system of incandescent lighting in the public lamps, the Committee were endeavouring to increase the efficiency of the street lighting with the least possible delay.

Before the Committee's proposals were adopted, Mr. Flint said he thought the officials and the Committee were to be heartily congratulated. The Chairman of the Council (Mr. J. L. Douglass) remarked that he entirely agreed with this; and he should like to go further, and say he thought the satisfactory result was to a very large extent due to Mr. Harris—as competent a Manager as any in the country.

SOUTHWARK AND VAUXHALL WATER COMPANY.

The Half-Yearly General Meeting of this Company was held at their Offices, Southwark Bridge Road, on the 14th inst.—Alderman Sir H. E. KNIGHT presiding.

The SECRETARY (Mr. Montague Watts) having read the notice calling the meeting, the report and accounts were taken as read.

The CHAIRMAN observed that he was glad to be able to call the proprietors' attention to the fact that all the prognostications which he ventured to place before them two or three half years ago as regarded the savings to be effected in the expenses of the Company by closing their Battersea works had been more than realized. Comparing the accounts for the half year ended March 31 last with those for the corresponding period of 1903, the charges for the maintenance and repair of mains, &c., were £1000 less, the pumping and engine charges were £5750 less, £646 less had been paid to the Thames Conservancy, and £3600 had been saved in rates and taxes. There had thus been a decrease of £11,000 in maintenance expenses. The proprietors would remember that he used to tell them that the Directors thought the saving would amount to at least £10,000. This reduction showed the wisdom of the policy that had been adopted in connection with the erection of the Company's new works at Hampton, which had brought them so much credit, and which, in fact, had placed them at the head of the London Water Companies as regarded the power and quality of their works. Under the head of management, they had had to pay £1000 more to the Chamberlain on account of the sinking fund; but more debentures had matured, and the payment to the Chamberlain must go on increasing so long as the Company continued to issue new capital. The other side of the revenue account did not appear, at first sight, to be quite so favourable as could be wished, or as the proprietors might have expected; but, nevertheless, it was perfectly satisfactory. It showed that the water-rents accrued for the half year were £149,115, against £157,540 for the corresponding period of 1903. Apparently, therefore, the revenue of the Company had decreased by £8425. In the corresponding period of 1903, however, they received from the East London and the New River Companies no less than £11,918 for water supplied to them. The difference between the £8425 and the £11,918 must therefore be looked at, and this £3493 showed the increase in the normal business of the Company. It would, therefore, be erroneous to imagine that their business was not progressive because the apparent decrease referred to was shown; for it was an absolute fact that from normal circumstances, which might be expected to continue, an increase of £3493 was shown in their revenue for the past half year. The amount carried to the dividend and interest account for transfer of profits was £77,767, or £1180 more than a year ago; but, nevertheless, the amount available for dividend was £8400 less. This, however, was very easily accounted for. From the circumstances stated—their abnormal supply to the East London and New River Companies—the Directors were enabled a year ago to carry forward a balance to the credit of the following half year of £6500 more than was carried forward last time to the assistance of the half year under review. The Company had also had to pay £500 more for debenture stock interest and £650 more for intercommunication stock interest, as well as £1000 for interest on temporary loan. These items altogether made £8650 more to come off the amount carried forward for the division of profits than had to be taken off at the corresponding period last year. Deducting this from the balance available, the sum applicable to dividend was £31,224 against £39,679. Therefore the Directors could not pay the same rate. It was, of course, unpleasant for them to recommend, and equally unpleasant for the proprietors concerned to receive, a smaller dividend; but it was the result of legitimate trading, and did not arise from any want of prosperity in the undertaking, which was still going on. It was, in fact, the result of circumstances which the Directors could not control. Passing to the report, he referred to the issue of debenture stock "B" on March 22 last, and stated that the applications represented about three or four times the amount offered. Since then, as the proprietors were aware, the Directors had issued another £100,000 of "B" debenture stock, which was tendered for by the public in the previous week, when the amount offered to the Company was no less thon £500,000. The sum asked for was allotted; the bulk of it being taken at prices above 91, and those who offered 91 did not get all they applied for. The paragraphs in the report dealing with the matters in connection with the approaching transfer were most important; but it was very difficult for him to speak as fully as he would like to do about them—in fact, it was impossible—as so much in connection with them was at present *sub judice*. It would be remembered that a conditional award had been made by the Arbitrators, but as yet there had been no real award. As he had said, the award so far made was conditional—a certain sum under certain circumstances and a certain extra sum under other circumstances, which other circumstances (in connection with the question of the contribution to the sinking fund) had not yet been settled. Although the decision of the Arbitrators and that of the Court of Appeal had been given against the Companies, yet the matter was of such importance, and the expense of carrying it to the House of Lords was so small in comparison with the large amount of money at stake, that they had felt it to be their duty to take the case to that tribunal. It was hoped that the House of Lords would find time to deal with the case before the end of the present month; and, if so, the Directors would then be in the position contemplated by the Act. The award would have been made, and, in pursuance of the provisions of the Act, they would then have to put a scheme before the shareholders for the division of the money. As soon as possible after they got the conditional award—in March last, he believed—they very carefully considered the matter, and issued a circular giving an approximate idea of what each class of the shareholders might expect to obtain. Very few replies to the circular were received; and the Directors had thoroughly well considered them, to see whether there was anything in them which might induce them to alter their decision. After much anxious care and thought, and weighing everything fully, he could not see that anything was brought before them, on a sound basis, to materially alter the decision they arrived at in March. The scheme would be most carefully prepared by the Directors, who would be well advised in regard to it. On the 24th inst., as the proprietors were aware, the Company, who had been doing their work for considerably over 100 years, would cease to be responsible for the supply of water. He had been their Chairman or a member of the Board for something approaching a third of a century. The Directors had still very important duties to discharge. They had to make out a balance-sheet for the quarter ended the 24th inst., and many little questions would have to be considered in preparing it. Then, the distribution of the compensation award would take an immense amount of care and time. The dissolution of the Company would follow; and he saw no reason why they should not look with confidence to the end. The dividend now proposed on the 5 per cent. preference stock was calculated to the 24th inst.; and there would be nothing further for the holders of that stock to receive from the Company. The "D" and the ordinary shareholders, however, would only be paid their dividend up to March 31 last, and there would therefore be a quarter's dividend to be paid to them after the balance-sheet to the 24th inst. had been got out. The Secretary also reminded him of another point of some importance—namely, that the dividends this time would be payable on the 23rd inst., or about three weeks earlier than usual. He concluded by moving the adoption of the report and accounts.

Mr. CHARLES MARSH VIALLS seconded the motion, which was carried unanimously.

The CHAIRMAN afterwards proposed the payment on the 23rd inst. of the following dividends: At the rate of 5 per cent. per annum on the preference stock calculated to June 24, and 6 per cent. per annum on the ordinary stock and "D" shares calculated to March 31 last.

Mr. VIALLS seconded the motion, which was carried unanimously.

The CHAIRMAN afterwards proposed, and Mr. VIALLS seconded, a resolution, which was also carried unanimously, granting a donation of £65 towards the maintenance of the Hampton Schools for 1904.

A resolution was subsequently brought forward by two of the proprietors for voting £5000 to the Directors and £7000 to the officers and staff of the Company, in recognition of their services generally, and particularly in connection with the arrangements relating to the transfer of the undertaking to the Water Board.

The CHAIRMAN stated that the Directors had no idea that such a proposal was about to be made, and they knew that it arose from the kindest of feelings. Anticipating what they felt sure would be the wishes of the proprietors, they had already handsomely considered the services of the staff in the winding-up of the concern, although there might still be some other consideration as regarded the staff. So far, however, as the Directors were concerned, while they were grateful

for what had been said of them, he asked that the proposal might be adjourned until the next meeting, when they would be quite contented to leave themselves in the hands of their constituents, knowing that they would be well treated.

The resolution was thereupon withdrawn; and the proceedings terminated with a vote of thanks to the Chairman, Directors, and staff.

CHELSEA WATER-WORKS COMPANY.

The Half-Yearly General Meeting of this Company was held at their Offices, Commercial Road, Pimlico, last Thursday—Mr. FRANCIS STEPHEN CLAYTON in the chair.

The SECRETARY (Mr. G. H. Gill) read the notice calling the meeting, and subsequently the certificate of the Government Auditor and the report of the Company's Auditors. The latter expressed their entire satisfaction with the clear and precise way in which the accounts had been kept.

The GOVERNOR then proposed the adoption of the report and accounts. He remarked that the long career of the Company was fast drawing to a close. It was established in 1723; and during the lengthened period of 181 years which had since elapsed, the concern had had rather a varied experience. In their early days, the Company had to contend with many adverse circumstances—indeed, it was only during the last fifty years that the wheel of fortune turned and they became prosperous. When he joined the Board in 1868, the Company were paying a dividend of 6 per cent. on their ordinary stock, and they were now paying 12 per cent.—a very good record, he ventured to think. On the 24th inst.—being the appointed day under the Metropolis Water Act, 1902—their undertaking would be transferred to, and vested in, the Water Board. In the meantime, the Directors presented the accounts for the half year ended March 31 last. There had been an increase of £1323 in the gross income as compared with that of the corresponding six months of last year, and an apparent increase of £207 was shown in the working expenses; but inasmuch as expenditure amounting to £906 was charged against the contingency fund last year, there was, in fact, a decrease of about £700 in the expenses compared with those of the corresponding period of 1903. Considering that this was the "lean" half year, the result was highly satisfactory. There had been 215 new supplies laid on in the six months, and these were estimated to produce an increased water-rental of £1605 per annum after allowing for temporary loss of income for houses pulled down for improvements during the same period. The Directors recommended dividends at the rate of 12 per cent. on the ordinary stock and at the prescribed rates of 5 per cent. and 4½ per cent. respectively on the preference stocks. Besides this, there would be a further and final dividend for the three months up to the appointed day. This would be paid later on. As mentioned in the Directors' report, the Court of Arbitration had made an alternative award in the Company's case—naming one amount if the legal question referred to the Court of Appeal should be decided in their favour, and another, and a smaller sum, in case of an adverse decision. The point of law was ably argued by Counsel on behalf of the Company before the Court on April 14 last, when, without calling on Counsel for the Water Board, the Court dismissed the appeal with costs. After careful and anxious consideration, the Directors came to the conclusion that the decision should be accepted as final, and that it would not be advisable to take the case to the House of Lords. The Directors were giving their closest attention to the preparation of a scheme for the distribution of the compensation money between the different classes of stock; and it would shortly be in the hands of the proprietors. In framing the scheme, it would be the earnest desire of the Directors to act fairly and equitably towards each class of stock; and he ventured to hope that the decision of the Directors would be acceptable to the proprietors generally as fairly meeting the justice of the case between their respective interests. In conclusion, he remarked that a period of profound anxiety had been experienced by the Directors, who had given the closest attention to the Company's affairs. They had all along received the greatest possible assistance from their excellent and highly efficient Secretary, the Assistant-Secretary (Mr. Harrison), the Engineer, and the staff generally; and last, but not least, he must add the high appreciation entertained by the Directors of the important services rendered to the Company by their able Solicitor, Sir John Hollams. He might add that on the appointed day they would hand over to the Water Board a splendid property, which was in first-rate condition; and he was satisfied that they would soon discover that they had obtained an excellent bargain, for which they would not have paid too dearly.

The DEPUTY-GOVERNOR (Mr. Jackson Hunt) seconded the motion.

The GOVERNOR, in answer to a question, stated that under the Metropolis Water Act the scheme was to be circulated among the proprietors; and unless objection were raised to it by a certain number, it would take effect one month after its issue.

A PROPRIETOR expressed the hope that the future of the staff would be safeguarded.

The GOVERNOR replied that the proprietors might rely upon it that the Directors would not forget this part of their duty. The motion was then put and carried unanimously; and the dividends mentioned were afterwards approved.

The GOVERNOR next proposed—"That the Directors of the Company be and they are hereby authorized, under the powers in that behalf contained in the Metropolis Water Act, 1902, to enter into an agreement on behalf of the Company with the Metropolitan Water Board for the discharge of the compensation awarded to the Company for the transfer of their undertaking wholly or partly in water stock, upon such terms as to price of issue of such water stock and in all other respects as the Directors in their discretion shall think fit; and the Directors may affix the common seal of the Company to any agreement they may enter into with the Water Board for this purpose." The Directors

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 850.

Issue.	Share.	When ex. Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.	GAS COMPANIES.			£ s. d.
590,000	10	Apl. 14	10½	Alliance & Dublin 10 p.c.	20–21	..	5 0 0
100,000	10	,,	7½	Do. 7 p.c.	13–14	..	5 7 2
200,000	5	May 12	6½	Bombay, Ltd.	6–6½	..	5 4 0
140,000	5	,,	6½	Do. New, £4 paid	4⅜–5⅛	..	4 18 11
380,000	Stk.	Feb. 25	12	Brentford Consolidated	242–247	..	4 17 2
300,000	,,	,,	9	Do. New	182–187	..	4 16 3
50,000	,,	,,	5	Do. 5 p.c. Pref.	127–132	..	3 15 9
206,250	,,	June 0	4	Do. 4 p.c. Deb.	102–105*	..	3 16 2
220,000	Stk.	Mar. 10	10½	Brighton & Hove Orig.	212–217	..	4 19 1
246,320	,,	,,	7½	Do. A. Ord. Stk.	150–155	..	5 0 0
400,000	20	Apl. 14	10	British	38½–39¾	..	5 1 3
100,000	Stk.	Feb. 25	6	Bromley, Ord. 5 p.c.	116–120	..	5 0 0
165,700	,,	,,	4½	Do. do. 3½ p.c.	89–93	..	4 16 9
500,000	10	May 12	7	Buenos Ayres (New) Ltd	10⅞–11¼	..	6 4 5
250,000	Stk.	Dec. 30	4	Do. 4 p.c. Deb.	94–96	..	4 3 4
150,000	20	Mar. 10	8½	Cagliari, Ltd.	21–23	..	7 3 6
100,000	10	May 27	10	Cape Town & Dis., Ltd.	14–15	..	6 13 4
50,000	50	May 3	6	Do. 6 p.c. 1st Mort.	51–53	..	5 13 2
1,375,000	Stk.	Feb. 25	5 2/10	Commercial 4 p.c. Stk.	110–114	..	4 11 3
556,485	,,	,,	5	Do. 3½ p.c. do.	106–109	..	4 11 9
442,947	,,	June 10	3	Do. 3 p.c. Deb. do.	85–87*	..	3 9 0
800,000	Stk.	June 10	7	Continental Union, Ltd.	112–117*	− ½	5 19 8
200,000	,,	,,	7	Do. 7 p.c. Pref.	142–147*	+2	4 15 3
575,000	Stk.	Feb. 25	5⅛	Crystal Palace Ord. 5 p.c.	118–123	..	4 6 8
60,000	,,	,,	5	Do. 5 p.c. Pref.	120–125	..	4 0 0
112,533	,,	Jan. 14	5	Do. 5 p.c. Deb. Stk.	135–140	..	3 11 5
486,090	10	Jan. 28	11†	European, Ltd.	18½–19¾	..	5 12 10
354,060	10	,,	11†	Do. £7 10s. paid	13½–14¾	..	5 13 10
15,243,200	Stk.	Feb. 11	4 1/16	Gas-light and Coke 4 p.c. Ord.	92–94	+1	4 13 7
2,600,000	,,	,,	3⅜	Gas-light and Coke 3½ p.c. max.	89–91	..	3 16 11
3,799,735	,,	,,	4	Gas-light and Coke 4 p.c. Con. Pref.	108–111	..	3 12 1
4,193,975	,,	Dec. 11	3	Gas-light and Coke 3 p.c. Con. Deb.	88–90	..	3 6 8
258,740	Stk.	Mar. 10	5	Hastings & St. L. 3½ p.c.	90–95	..	5 5 3
70,000	10	Apl. 28	11	Hongkong & China, Ltd.	15–16	..	6 17 6
3,800,000	Stk.	May 12	10	Imperial Continental	202–205	..	4 17 7
473,600	Stk.	Feb. 11	3½	Do. 3½ p.c. Deb. Red.	97–99	..	3 10 8
165,242	Stk.	Mar. 10	6	Lea Bridge Ord. 5 p.c.	113–118	..	5 1 8
561,000	Stk.	Feb. 25	10	Liverpool United A	215–216	..	4 12 7
718,100	,,	,,	7	Do. do. B	159–161	..	4 6 11
306,083	,,	Dec. 30	4	Do. do. Deb. Stk.	108–110	..	3 12 9
75,000	5	Dec. 11	5	Malta & Medn., Ltd.	4¼–4⅝	..	5 5 3
560,000	100	Apl. 5	5	Met. of 5 p.c. Deb.	105–107	..	4 17 1
250,000	100	,,	4½	Melbourne 4½ p.c. Deb.	100–102	..	4 8 3
541,920	20	May 27	3½	Monte Video, Ltd.	9–10	..	7 0 0
1,515,892	Stk.	Feb. 26	4½	Newc'tle & G'tesh'd Con.	105–107	+2	4 4 1
406,025	Stk.	Dec. 31	3½	Do. 3½ p.c. Deb.	93¼–94½	..	3 14 1
300,000	Stk.	May 12	8	Oriental, Ltd.	138–143	..	5 11 11
600,000	5	Mar. 29	7	Ottoman, Ltd.	6⅞–6¾	..	5 12 0
					* Ex div.		

Issue.	Share.	When ex. Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.	GAS COMPANIES.			£ s. d.
£35,005	Stk.	—	6⅛	Ply'mth & St'house 5 p.c	—	..	—
851,070	10	Apl. 28	7	River Plate Ord.	10⅞–11¼	..	6 4 5
300,000	Stk.	Dec. 30	4	Do. 4 p.c. Deb.	93–97	..	4 2 5
250,000	10	Mar. 29	7	San Paulo, Ltd.	10⅜–11⅛	..	6 1 9
135,000	Stk.	Mar. 10	10	Sheffield A	237–239	..	4 3 8
209,984	,,	,,	10	Do. B	256–258	..	4 4 0
523,498	,,	,,	10	Do. C	235–237	..	4 4 5
116,106	Stk.	—	5	Shrewsbury Ord. 5 p.c.	—	..	4 10 11
6,150,000	Stk.	Feb. 11	5⅛	South Met., 4 p.c. Ord.	125–127	..	4 3 11
1,832,700	,,	Jan. 14	3	Do. 3 p.c. Deb.	89–91	..	3 5 11
380,940	Stk.	May 12	5	Southampton Ord.	105–110	..	4 10 11
87,950	,,	,,	4	Do. 4 p.c. Deb.	—	..	—
120,000	Stk.	Feb. 25	6	Tottenham and Edmonton A. 5 p.c. B. 3½ p.c.	122–125	..	4 16 0
313,020	,,	,,	4½		97–102	..	4 8 3
182,380	10	June 10	8	Tuscan, Ltd.	8¼–8¾*	..	9 2 10
149,000	10	Jan. 2	5	Do. 5 p.c. Deb. Red.	97–99	..	5 1 0
745,872	Stk.	Mar. 10	5	West Ham, 5 p.c. Ord.	97–102	..	4 18 0
				WATER COMPANIES.			
781,517	Stk.	Dec. 30	12	Chelsea, Ord.	360–365	..	3 5 9
150,000	,,	,,	5	Do. 5 p.c. Pref.	147–152	..	3 5 9
160,000	,,	,,	4½	Do. 4½ p.c. Pref. '75	137–142	..	3 3 5
175,785	,,	Mar. 29	4½	Do. 4½ p.c. Deb.	132–137	..	3 5 8
1,720,560	Stk.	Mar. 23	8	East London, Ord.	220–225	..	3 11 1
654,740	,,	Dec. 11	4½	Do. 4½ p.c. Deb.	134–139	..	3 4 9
1,524,288	,,	,,	3	Do. 3 p.c. Deb.	89–92	..	3 5 2
700,000	50	June 10	11†	Grand Junction 10 p.c. max.	134–138*	..	4 6 11
310,000	Stk.	Mar. 29	4	Grand Junction 4 p.c. Deb.	115–120	..	3 6 8
708,000	Stk.	Feb. 25	10	Kent	320–325	..	3 1 6
160,000	,,	,,	7	Do. New, 7 p.c. max.	223–228	..	3 1 5
1,043,800	100	Dec. 30	11	Lambeth, 10 p.c. max.	317–322	..	3 8 4
436,200	100	,,	8½	Do. 7½ p.c. max.	230–235	..	3 12 4
350,000	Stk.	Mar. 29	4	Do. 4 p.c. Deb.	115–120	..	3 6 8
500,000	100	Feb. 25	10	New River, New Shares	580–590	+5	2 11 3
1,000,000	Stk.	Jan. 28	4	Do. 4 p.c. Deb.	118–121	..	3 6 2
902,300	Stk.	Dec. 30	7½	Southwark Ord.	278–283	+1	2 13 0
126,500	100	,,	7½	Southwark 7½ p.c. max.	215–225	..	3 6 8
489,200	Stk.	,,	5	Southwark and Vauxhall 5 p.c. Pref.	144–149	..	3 7 1
1,019,585	,,	Mar. 29	4	Vauxhall 4 p.c. A Deb.	115–120	..	3 6 8
1,155,066	Stk.	May 27	10	West Middlesex.	300–304	+1½	3 5 9
200,000	,,	June 0	4½	Do. 4½ p.c. Deb.	130–135*	..	3 6 8
200,000	,,	Mar. 10	3	Do. 3 p.c. Deb.	89–92	..	3 5 2
					* Ex div.		

† Next dividend will be at this rate.

had, he said, given their most anxious consideration to the subject, and he need scarcely say that, in proposing the resolution, they were acting under the advice of the Company's Solicitor. There could be no doubt that very many of the proprietors, especially in trust accounts, would prefer to take their compensation in water stock instead of cash, and about 52 per cent. of the holdings were trust accounts. Those proprietors who preferred cash could, of course, sell the water stock and reinvest in other securities. It would be practically impossible to give each proprietor the option of taking stock or cash, as so much time would be consumed in ascertaining their wishes—especially in trust accounts, where there might be three or four names on the account—that the Directors would very probably, through the delay, lose the opportunity of negotiating with the Water Board. Moreover, the terms of issue had not at present been disclosed. Any agreement on the subject must be entered into with the Company, and not with the individual proprietor. If no such agreement should be entered into, the compensation would be paid in cash not later than Dec. 24 next.

The DEPUTY-GOVERNOR seconded the motion.

A PROPRIETOR asked if there was any provision for interest on the stock or cash to be paid to the proprietors.

The GOVERNOR replied that, as regarded stock, it depended upon the terms on which it was issued. If they were paid in cash, he took it that they would receive six months' dividend from the Water Board to next January.

The motion was carried unanimously.

The retiring Directors—Sir H. B. Poland, K.C., Mr. George Fenn Aston, and Mr. Herbert H. Child—and the retiring Auditor, Mr. Clement Stone-Wigg, were afterwards re-elected.

Mr. JOHN DREW then proposed a resolution authorizing the Directors to set aside £2000 out of the undivided profits for their ordinary remuneration during the winding-up of the Company's affairs.

The motion was seconded and carried unanimously.

The GOVERNOR, in acknowledging the vote, observed that it was testimony on the proprietors' part of their confidence in the Directors, who, he hoped, would continue to perform their duties in such a way as to show that the vote was justified.

Mr. STONE-WIGG said he wished to urge the desirability of some allowance being made for the staff in the winding-up of the concern, though he would not bring forward a motion naming any sum.

The GOVERNOR, in reply, stated that the subject referred to had occupied the thoughts of the Directors for some time, and he could assure the proprietors that, in preparing their scheme for the distribution of the compensation money, they would make a proper reserve to enable them to give an allowance or *solatium*—or whatever it might be termed—for loss of office to the members of the staff, from the highest to the lowest, who were worthy of it.

On the motion of Mr. DREW, a cordial vote of thanks was afterwards passed to the Governor, the Deputy-Governor, the Directors, and the staff.

The GOVERNOR briefly replied; and the proceedings terminated.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The accounts and estimates of the Dundee Corporation Gas Department have now been adopted. So much has been written regarding them before the event, that, now it has taken place, there is little to add. Mr. Ritchie, as a matter of fact, said very little, from which circumstance I take it that the undertaking, though greatly improved in its prospects, is still a source of anxiety to Corporation financiers. There is no dubiety about the carrying on of the works. They are in the best of hands; and if the undertaking ever comes to be in a position which will be satisfactory generally, it is safe to assume that such a state of matters will be more the doing of Mr. Yuill than of anybody else.

The report of Mr. A. C. Young, the Manager of the Arbroath Corporation Gas Department, for the year ending May 15, was submitted at a meeting of the Town Council on Monday. The gas manufactured during the year amounted to 77,379,600 cubic feet—an increase over the previous year of 6,611,400 feet. The gas sold was 70,132,681 cubic feet—an increase of 5,543,799 feet. Allowing for the gas used in the works, there remains 5,710,221 cubic feet unaccounted for, which is equal to 7·38 per cent. of the manufacture. In the previous year, the gas unaccounted for amounted to 7·70 per cent. The revenue from the sale of gas was £12,601, as compared with £14,259, representing a saving to the community of £1658, irrespective of the additional quantity supplied. There are now 290 cooking-stoves on hire, and 526 prepayment meters in use. The rental received for cooking-stoves was £216—an increase of £51. Mr. Robbie moved approval of the report. He pointed out that when the increased consumption was taken into account, it was seen that the saving to gas consumers was £2900; so that the reduction in the price last year had been an entire gain to the public. Instead of putting aside £750, as recommended by Mr. Gillespie when he valued the gas-works, for the purpose of making an asset which did not exist at that time, they had set aside three times this amount, or £2100, which made a total saving to the community in the past year of £5000, besides which the works had increased in value by £4000 during the past eighteen months. The report was adopted. It was reported that since a Sheriff officer had been employed to recover arrears which were due for gas consumed, a sum of £371 had been recovered. This was considered to be satisfactory; and it was agreed to continue the arrangement.

At the Glasgow Town Council on Thursday, Mr. Burgess, who has, or had, a connection with the Gas Workers and General Labourers' Union, moved that a recommendation of a Special Gas Sub-Committee, dated May 22, 1899, and adopted by the Council, to the effect that the Managers of the gas-works should observe the rule of the Corporation that, so far as practicable, ratepayers should get the preference of employment, be amended so as to read "that the Station Managers, in engaging extra men for the winter months, be instructed to confine such

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engagements to applicants who can show a record of twelve months' continuous residence in Glasgow at the time the engagement is made, and that, of such applicants, preference be given, as far as practicable, to ratepayers." After some little discussion, the motion was sent to the Gas Committee for consideration. Mr. R. M. Mitchell, the Convener, moved a recommendation by the Gas Committee, that the maximum salary of outdoor gas collectors be increased from £120 to £130. Mr. Willock moved disapproval of the recommendation. Mr. Paton suggested that gas collectors should be done away with, and that the gas-rents should be paid at the office. Mr. W. F. Anderson blamed the grading scheme for the whole trouble. The Council, by 33 votes to 13, rejected the recommendation.

The Gas Commissioners of Peebles have let several of the contracts for the new gas-works which they are in process of building. The erection of the retort-bench and separating tank has been let to Messrs. C. M. & J. Hamilton, of Hamilton, at the price of £615; and the iron and steel work in the retort-house to Messrs. Henry Balfour and Co., Limited, of Leven, Fife, for £647. The supply of fire-clay retorts has been contracted for with the Glenboig Union Fire-Clay Company.

The Bothwell and Uddingston Gas Company, Limited, had a revenue last year of £11,270, of which £7061 was derived from the sale of gas, £2196 from coke, £833 from tar, and £1025 from sulphate of ammonia. The balance at the credit of the profit and loss account was £2575; but with the balance from the previous year it was made up to £3074. A dividend at the rate of 10 per cent. was paid, and £774 carried forward. Gas sold amounted to 48,386,000 cubic feet. The coal carbonized was 7795 tons. Of coke there was sold 4381 tons, of tar 83,210 gallons, and of sulphate of ammonia 88 tons.

At the Denny Town Council on Tuesday, Mr. Luke, the Convener of the Gas Committee, in submitting the accounts for the past year, said there was a decrease shown in the balance at the credit of profit and loss account amounting to £136. But he was sorry to say that things were really worse than was shown, because they had credited the revenue with £111, so that actually the decrease was £248. This might seem a little alarming, in view of the bid they made for a greater consumption of gas by reducing the price last year (by 10d. per 1000 cubic feet); but the Committee had gone very carefully into the accounts, and they by no means took a gloomy view of affairs.

The decision of the Court of Session in the action relating to the fitting up of an installation of plant for the supply of aëro-gas at Queensferry, may have an interest beyond the mere settling of a dispute between a purchaser and a contractor. [A report of the case will appear next week.] The plant which was employed here was of practically the same design as that which is used in installations for the supply of Notkin gas. The process is the same—that of producing an inflammable vapour by filtering oil through porous material. This vapour is found to be heavier than the atmosphere; and consequently, in the Notkin plant, the carburettors or gas-producers are placed above the level of the burners—the gas flowing down to the point of combustion. It is considered to be an improvement upon the Notkin method to employ a compressor, because, by its operation, the gas can be made to rise. The Queensferry installation included a compressor. It was placed in the basement flat; and it had to supply gas for three flats above. The decision of the Court was that the plant was unequal to the supply of burners distributed over several storeys of the building. Though not based upon scientific principles, the decision raises the question of the feasibility of satisfactorily applying such a method of gas supply to an extensive scheme of lighting. There is no provision for storage of the gas; and consequently, when lights upon one flat of a building are put on or taken off, the operation disturbs the action of the apparatus, and the light becomes jerky until it can adjust itself (if it be capable of doing so) to the new conditions. Somewhat of an analogy to this case would be found if an attempt were made to light a building or a street by means of coal gas drawn direct from the retorts. It needs no demonstration to show that, even with pressure applied so as to keep the supply-pipes full, it would not be a success, though, in such a case, the intervening apparatus would make the fluctuations less acute than they are in such installations as that at Queensferry, where there was no condensing, scrubbing, or purifying performed. It would almost seem as if, for the supply of this gas efficiently, the best method would be to have a carburettor upon every flat of a building, and perhaps also for every room. Of course, the method of gas supply is only suitable for detached places like country houses; but for these it is exceedingly handy and profitable.

The Leven, Fife, Gas Company had an increased consumption of gas last year of 2½ million cubic feet. A dividend at the rate of 6 per cent. has been declared, and the price of gas reduced by 5d. per 1000 cubic feet; making it 3s. 4d. to ordinary consumers, and 2s. 11d. for power purposes. The Kinross and Milnathort Gas Company have paid a dividend at the rate of 7½ per cent., and, after allowing £134 for depreciation, have carried forward £180. At the annual meeting of the Dalbeattie Gas Company last week, it was reported that the profit for the year amounted to £230. During the year the price of gas had been lowered to 5s. per 1000 cubic feet—a reduction of 10d. A dividend at the rate of 5 per cent. was declared. The Earlston Gas Company have paid a dividend at the rate of 4s. per share for the past year; and the price of gas has been reduced from 5s. 10d. to 5s. 5d. per 1000 cubic feet.

What has been described in popular language as the "Wishaw Gas Scandal" has been settled. It will be remembered that the Gas Manager lost his situation over it. It arose about the purchase of coal from a small colliery in the neighbourhood (one of the Magistrates being mixed up in the business), which resulted in the Corporation being charged 20s. per ton for what was sold at the colliery for 11s. The Magistrate is now out of office. The Town Council employed a private detective to make investigations; and on receiving his report, they made a demand upon the parties implicated for a money payment. This was refused; and thereafter a summons in the Court of Session was served. The action has been settled, however, by a payment of £150 in settlement of the claim and expenses.

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CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *June* 18.

Sulphate of Ammonia.

The market has been somewhat irregular; and in some cases very full prices have been paid. On the whole, there has been a slight improvement in values; and the closing quotations are £11 17s. 6d. to £12 per ton f.o.b. at the ports. The very low speculative quotations abroad, current in the early part of the month, having been withdrawn, the interest of Spanish and Colonial buyers has revived; but their views are scarcely yet in line with the improved market, while the Continent remains indifferent. The very firm attitude of makers seems to have stopped speculative buying in the forward position. There has been large direct inquiry; but, again, buyers have not adjusted themselves to the altered situation, and the volume of actual business has consequently been limited.

Nitrate of Soda.

This article remains firm at 10s. to 10s. 3d. per cwt., according to quality.

LONDON, *June* 17.

Tar Products.

The markets for tar products still continue very quiet; and there is an absence of business. The position of pitch remains unchanged. London makers are open to sell at from 32s. to 32s. 6d.; while on the east coast makers as a rule ask 32s. 6d., as best Yorkshire pitch is at present commanding rather better prices than other makes. Consumers, however, decline to pay the equivalent of these prices, and generally offer 1s. per ton below the makers' quotations. In creosote, the market continues very steady, and there has been a fairly good business doing in the North; but as regards London, it is still difficult to arrange business for export, owing to the scarcity of barrels. The position of anthracene remains unchanged; and it is reported that there is more inquiry all over next year. Manufacturers, however, decline to accept 2d. per unit, and as a rule ask 2½d. for "A" quality, London make. The demand for crude carbolic continues good; fair business being done at 2s. per gallon for July-September delivery. But consumers do not care to purchase up to the end of the year. Toluol is again quiet; and the demand appears to have again fallen off. London makers are reported to be offering at 6¾d., without finding buyers. There are still sellers of benzol at 9¼d. f.o.b. London; but consumers will not pay more than 9d., which may be taken as about the market value. In 50-90 per cent., there is really no business doing. Sellers ask 7¼d.; but consumers will not pay more than 7d. at present, and there is really very little demand for this quality. In solvent naphtha there is more business doing in the North, where it is reported that 6½d. was accepted for ordinary 90 per cent. at 160° for export. London makers still ask 8d. per gallon for their best quality.

The average values during the week were: Tar, 17s. 6d. to 22s. 6d. Pitch, London, 31s. 6d. to 32s.; east coast, 32s.; west coast, 30s. to 30s. 6d. Benzol, 90 per cent., 9d.; 50-90 per cent., 7d. to 7¼d. Toluol, 6½d. to 6¾d. Crude naphtha, 3d.; solvent naphtha, 6½d. to 8d.; heavy naphtha, 10d. to 10½d. Creosote, London, 1½d. to 1 9/16d.; North, 1⅝d. Heavy oils, 2¼d. Carbolic acid, 60 per cent., 2s. Refined naphthalene, £5 to £8; salts, 22s. 6d. to 24s. Anthracene, "A" quality, 1¾d. to 2d.; "B" quality, 1d., nominal.

Sulphate of Ammonia.

The market closes steady; and prices have an upward tendency. Beckton have raised their price to £12; while another large London Gas Company report having sold at £12 2s. 6d. on their own special terms, and now ask £12 5s. Business is reported in London at £11 17s. 6d., Beckton terms; and this price may be taken as the value in London. In Hull, the market is firm; and business is reported at both £11 16s. 3d. and £11 17s. 6d. for fair quantities, for prompt delivery. The market closes steady at £11 17s. 6d. Liverpool is firm at £11 16s. 3d. to £11 18s. 9d. Leith is very firm. Makers are reported to have both accepted and refused £12; while for forward delivery they ask £12 5s.

COAL TRADE REPORTS.

Lancashire Coal Trade.

Generally, there is no new feature of special importance to notice in connection with the coal trade of Lancashire. Three days continues about the general average that pits are running; and this restricted output is just about moving away, though here and there stocks of some descriptions of round coal accumulate. House-fire qualities are without quotable alteration; but prices are regulated a good deal according to special conditions. The same applies to engine fuel. At the pit mouth, quoted rates may be given as 13s. to 14s. per ton for best Wigan Arley, 11s. to 12s. for seconds Arley and Pemberton four-feet, and 8s. 6d. and 9s. to 10s. for common house-fire coals. Steam and forge coals are from 7s. 6d. and 7s. 9d. up to 8s. and 8s. 3d. per ton at the pit. In gas coals, there have been a few further transactions upon much the same basis as reported of late. Nominally, a reduction of about 6d. is a general rule, with only 3d. giving way. Good screened Wigan Arley gas coals remain at 9s. 6d. to 9s. 9d. and 10s. per ton at the pit, with Wigan four-feet 7s. 9d. and 8s. 3d. to 8s. 6d. and 8s. 9d. Engine fuel just moves off fairly; the restricted output preventing any large surplus on the market. Prices are about steady at late rates; averaging 6s. to 6s. 6d. per ton for best slack, 5s. to 5s. 6d. for medium, and 4s. to 4s. 6d. for common.

Northern Coal Trade.

There is a fair, but not a pressing, demand for coals; and the collieries, on the whole, are working well. Best Northumbrian steam coals are from 10s. 3d. to 10s. 6d. per ton f.o.b., second-class steams

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are 8s. 9d. to 9s., and steam smalls are 4s. 3d. to 4s. 9d. Durham coals are, for certain kinds, naturally a little easier at this season of the year. Gas coals are now at the period of lowest demand; but the prices only vary, according to quality, from about 7s. 10d. to 8s. 4½d. per ton f.o.b., with a moderate inquiry for occasional cargoes. In contracts, one is in close treaty for a south-country town; and it is expected that good Durham gas coals will command nearly 8s. per ton f.o.b. Coke is steady, and gas coke is currently quoted at from 13s. 3d. to 13s. 6d. per ton f.o.b. in the Tyne.

Scotch Coal Trade.

The market remains quiet. The production is more than equal to the demand; all sorts of coal being plentiful. The most disappointing feature is the export trade, which is not coming up to expectations. The prices quoted are: Main 7s. 3d. to 7s. 6d. per ton f.o.b. Glasgow, ell 9s. to 9s. 3d., and splint 8s. 3d. to 8s. 9d. The shipments for the week amounted to 196,949 tons—a decrease of 61,784 tons upon the preceding week, and of 22,503 tons upon the corresponding week of last year. For the year to date, the total shipments have been 4,776,293 tons—an increase of 132,319 tons upon the same period of 1903.

Electric Lighting Loss at Newport (Mon.).—The past year's working of the Newport (Mon.) electric light undertaking has resulted in a deficit of £225, without anything being allowed for depreciation. Mr. W. H. Brown, the Chairman of the Electricity Committee, however, contends that so long as the sinking fund and interest are provided for, and the works are properly maintained, this is all that need be expected. While there is no profit, there can be nothing put aside for depreciation; but he hopes that, when there is a profit, something may be provided in relief of the rates, and a sum for depreciation. No indication is vouchsafed as to when this is likely to be.

Selby Gas Supply.—During the year ending March 31, the make of gas at Selby was 38,395,700 cubic feet, or an increase over the previous twelve months of 1,760,700 cubic feet. The gross profit for the year was £3301, which is equal to 13·72 per cent. interest on the capital employed. In presenting these facts to the Council, the Chairman (Mr. Mark Scott) observed that, to say the very least of it, their thanks were due to the Gas Engineer and Manager (Mr. T. H. Alderson), for the satisfactory results achieved. He moved a vote of thanks to Mr. Alderson for the very able way in which he had conducted the work of the Gas Department. The Vice-Chairman (Mr. T. S. Ullathorne) seconded the motion, which was supported by Mr. Bowe, who said that he went to other towns, and it was always a pleasure to return to Selby and see the streets so well lighted as they were. The resolution was unanimously passed, and Mr. Alderson acknowledged the vote, adding that he hoped they would be able to make a reduction in the price of gas when they had considered the coal tenders.

Gas and Electricity Supply at Huddersfield.—At the monthly meeting of the Huddersfield Town Council, the Gas Engineer (Mr. E. A. Harman) reported a slight increase in the quantity of gas used, with an addition of 73 consumers; whereas the report on the supply of electricity showed a decrease of 22 per cent. in the number of units metered during the month of May, compared with the corresponding period last year. The decreased quantity of electricity metered is significant.

Economy of Incandescent Gas Lighting.—The Borough Engineer of West Ham reported, at the meeting of the Corporation on Tuesday, that the installation of the new lanterns and incandescent gas lighting had been completed in the districts of the West Ham Gas Company and the Gaslight and Coke Company, and that the agreements entered into showed an immediate saving, so far as the gas lighting was concerned, at the rate of £1700 per annum during the next five years on the same number of lamps as were previously lighted by flat-flame burners, and at the end of this period at the rate of £2800. Satisfaction was expressed at this result.

Gas Affairs at Belfast.—At their last meeting, the Belfast Corporation Gas Committee had submitted to them the accounts for the year ending March 31, together with a report of the Accountant (Mr. D. Creighton). From these, it appeared that the gross profit on the manufacture and sale of gas during the year was £52,077, as compared with £41,526 in the previous year, or an increase of £10,551; while the net profit was £38,977, as against £28,488, or an increase of £10,489. The balance from last year's account, and other items, added to the net profit, made a total of £57,702, out of which £9233 had been set aside for sinking fund, &c., £15,000 handed over in aid of the rates, and £5378 contributed for the new City Hall. The total net profits of the undertaking during the thirty years the Corporation have owned it have been £887,280.

Ossett Gas Supply.—The annual report presented by the Gas Engineer of the Ossett Corporation (Mr. A. E. Mottram) shows most successful working in the past financial year. The completion of the rebuilding of the retort-house has enabled the whole of the gas for the twelve months to be produced under improved conditions. A gross profit of £7837 was made, compared with £5965 the previous year; and after payment of interest and sinking fund charges and writing something off the suspense account, there was left a net profit of £1132. There were 93,918,000 cubic feet of gas made, and 82,496,500 feet sold or used at the works; the unaccounted-for gas being 12 per cent. When the Corporation took over the works, the number of consumers was 3452; whereas there are now 5350—an increase of 1898 in two years and nine months. The Gas Committee have adopted the following scale of discounts for consumers: Over 20,000 and under 50,000 cubic feet, 5 per cent. per quarter; over 50,000 and under 100,000 cubic feet, 7½ per cent.; over this quantity, 10 per cent. It has also been decided to reduce the price of gas from 3s. to 2s. 9d. per 1000 cubic feet.

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Sales of Gas Stock.—At Bristol, last Thursday, Messrs. G. Nichols, Howes, Young, Alder, and Co., sold by auction £20,000 of general capital stock and £5000 of new debenture stock of the Bristol Gas Company. The former fetched prices ranging from £110 to £114 5s., and the latter £101 to £103 per £100 of stock. A few days ago, stock to the amount of £10,000 of the Hartlepool Gas and Water Company was sold by auction, in £100 lots, at premiums reaching as high as £24 per lot.

United Kingdom Lighting Trust, Limited.—At the ordinary general meeting of the Company last Wednesday, the Directors submitted the accounts for the twelve months ending the 31st of March, which showed a net profit of £2213. Allowing for the interim dividend and sundry amounts written off on account of preliminary expenses, investment, &c., there remained a disposable balance of £1314. The Directors recommended the payment of a further dividend of 4 per cent. on the ordinary shares, making a total distribution of 8 per cent. upon the ordinary capital for the period covered by the accounts. This would absorb £811, and leave £503 to be carried forward.

Begging for the Annual.—The stern opposition which has been given to the employees of gas undertakings begging from firms with which their employers do business, applies equally when "the boot is on the other leg." It may be of interest to the staff of Messrs. John Board and Co., Limited, of Bridgwater, to know that gas companies are not desirous of being molested by their solicitation on the occasion of their annual outing. The staff of the firm mention, in their printed circular-letter, that, as the firm have had transactions with the recipients, a donation is solicited towards the expense of the staff's annual outings, and contributions will be appreciated and acknowledged. No doubt. Our advice to gas companies is that, if transactions with the firm named is to lay them open to annoyance of this kind, they had better transfer their business to a firm whose staff will not similarly pester them.

Price of Gas in Bradford Out-Districts.—Some discussion has taken place in the Bradford City Council with regard to the price of gas in two of the out-districts. In calling attention to the matter, Mr. Dobson mentioned that at the time Thornbury and Tyersal came into the city (in 1882), there was a distinct understanding (which, however, was not in writing) that the price of gas should be reduced to the rate charged in Bradford. The gas was at present supplied by the Pudsey Gas Company at 2s. 6d. per 1000 cubic feet, as compared with 2s. 3d. charged by the Bradford Corporation; and the Company steadfastly refused to treat for any reduction. This being so, the ratepayers were compelled to throw themselves on the mercy of Bradford; and they desired some relief in the ordinary rates by way of compensation for the extra price they paid for gas. He moved that the Finance and Gas Committees should be instructed to take the matter into consideration, but withdrew his proposition on the Chairman of the former Committee (Alderman Godwin) giving an assurance that this should be done.

Testing Dorking Gas.—At the last meeting of the Dorking District Council, the Gas Examiner (Mr. Howard) reported that when he attended at the works of the Dorking Gas Company on the 30th of May, at 7.45 p.m. (the test having to be made between 8 p.m. and 11 p.m.), he found that the Manager (Mr. S. Carpenter) and his son were both away, and admission could not be gained to the testing-place until 10.30 p.m. It was recommended that Mr. Howard should be requested to make further tests at such times as he considered expedient; and this was agreed to.

Gas Preferred to Electricity at Camborne.—The Camborne Urban District Council have been considering tenders for lighting the town by gas and electricity. The Lighting Committee recommended the acceptance of the tender of the Gas Company at £2 7s. 6d. per lamp per annum; the lamps to be fitted with 80-candle power Kern burners. The contract to be for five years; and the Council to have the option within the next two years of making it a seven years' contract. The offer of the Urban Electric Supply Company was to light the town with 80-candle power Nernst lamps at £2 10s. each per annum, for a period of five years. The recommendation of the Committee was agreed to unanimously.

A Record Year at Ashton-under-Lyne.—The profits of the Ashton-under-Lyne Gas-Works for the past twelve months were nearly £2000 more than in any previous year. The income increased by £1150, while the expenditure decreased by £600. In making this gratifying statement to the Town Council, the Chairman of the Gas and Electricity Committee (Mr. W. L. Elliott) said that during the last seven years the number of slot meters in use had increased from 250 to 1750. The consumption of gas was now 120 million cubic feet; having increased by 28 millions in the same period. The capital was £90,000; but they had £17,000 in the sinking fund towards this. After setting aside £5650 for sinking fund, renewals, &c., there was a profit of £2575, of which £1950 had been paid over to the relief of the rates.

Hull Corporation Water-Works.—The water-works of the Hull Corporation at Springhead and Cottingham were inspected a few days since; and an interesting event in connection with the proceedings was the opening of the Raywell reservoir, which is to supply a rural district containing about 6000 inhabitants. The members of the Water Committee, accompanied by the Mayor (Alderman Jarman), and a number of officials, left the Town Hall shortly before noon, and drove to Springhead, where they spent some time in inspecting the machinery. Within the last six months a horizontal cross-compound engine has been added, from the works of Messrs. Hathorn, Davey, and Co., Limited, of Leeds, having a pumping capacity of 400 gallons per minute. Leaving Springhead, the party were driven to Raywell, where they descended into the reservoir. The floor, which is 114 feet long and 64 feet wide, is of concrete. No iron has been used in the work. The reservoir has cost, exclusive of the land, about £3000. The work has been carried out under the supervision of the Water and Gas Engineer to the Corporation, Mr. F. J. Bancroft, B.Sc.

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WINDSOR ST. WORKS, BIRMINGHAM	2,000,000	KINGSTON, PA.	125,000	STRETFORD	500,000
SALTLEY WORKS, BIRMINGHAM	2,000,000	PETERBOROUGH, ONT.	250,000	OLDBURY	300,000
COLCHESTER	300,000	WILKESBARRE, PA.	750,000	TODMORDEN	500,000
BIRKENHEAD	2,250,000	ST. CATHERINES (2nd Cont)	250,000	SALTLEY, BIRMINGHAM (Third Contract)	2,000,000
SWINDON (New Swindon Gas Co.)	120,000	BUFFALO, N.Y.	2,000,000	YORK (Second Contract)	750,000
SALTLEY, BIRMINGHAM (Second Contract)	2,000,000	WINNIPEG, MAN.	500,000	ROCHESTER (Second Contract)	500,000
WINDSOR ST., BIRMINGHAM (Second Contract)	2,000,000	COLCHESTER (Second Contract)	300,000	NEWPORT (MON.)	250,000
HALIFAX	1,000,000	YORK	750,000	TOKIO, JAPAN	1,000,000
TORONTO	250,000	ROCHESTER	500,000	PERNAMBUCO (Brazil)	125,000
OTTAWA	250,000	KINGSTON, ONT.	300,000	MALTON	150,000
LINDSAY (Remodelled)	125,000	CRYSTAL PALACE DISTRICT	2,000,000	DULUTH, MINN. (2nd Cont.)	300,000
MONTREAL	500,000	DULUTH, MINN.	300,000	BROCKVILLE (ONT.)	250,000
TORONTO (Second Contract Remodelled)	2,000,000	CATERHAM	150,000	SMETHWICK	500,000
BELLEVILLE	250,000	LEICESTER	2,000,000	GRAVESEND	300,000
OTTAWA (Second Contract)	250,000	ENSCHEDE (HOLLAND)	150,000	NEWPORT MON. (Second Contract)	250,000
BRANTFORD (Remodelled)	200,000	BUENOS AYRES (RIVER PLATE CO.)	700,000	TORONTO (Third Contract)	750,000
		BURNLEY	1,500,000	TORONTO (Fourth Contract)	1,000,000
		KINGSTON-ON-THAMES	1,750,000	MONTREAL, ONT. (2nd Cont.)	1,800,000
		ACCRINGTON	500,000	HAMILTON, ONT.	400,000

Complete Gas-Works at NELSON, BRITISH COLUMBIA.

LEEDS, 1,800,000 C. Ft. LEICESTER (2nd Cont.), 1,000,000 C. Ft. NEWCASTLE-ON-TYNE, 1,800,000 C. Ft.
AND, IN ADDITION, 3,000,000 CUBIC FEET DAILY.

Mansfield Gas and Water Supply.—At the meeting of the Mansfield Town Council last Friday, the report of the Gas Committee on the work of the undertaking in the past financial year was presented. It showed that the net profit, after payment of loans, Treasurer's interest, and contribution to the sinking fund, was £2909. Having regard to the facts that during the year the electricity works had been opened and a further reduction made in the price of gas, this was considered to be specially gratifying. Alderman Blake, in moving the adoption of the report, alluded to its very satisfactory character. He said he hoped the Committee might in the near future see if they could not afford to reduce the price of gas all round. The Water Committee, in their report on the year's working, showed that a net profit of £2232 had been made. The reports were adopted.

Dolgelly Water Supply.—Last Wednesday, at the Shire Hall, Dolgelly, before Colonel A. G. Durnford, R.E., an inquiry was held into the application made by the Dolgelly Urban District Council for a loan of £7000 for the purchase of the local water-works. Mr. D. Oswald Davies, on behalf of the Council, stated that the water was procured from Llyn Cynrn, and the application was made by the Council because of the inadequate supply furnished by the Water Company to the highest houses in the town, and consequent on the recommendation of the Medical Officer of Health that the supply should be under the supervision of the public authority. The Council and the Company had agreed upon the sum of £4000 as the purchase price for the works; the remaining £3000 they proposed to utilize on repairs. Mr. J. Jones Williams, on behalf of the Ratepayers' Union, objected to the loan being granted, because a mining company had power to draw water from the lake. Objections were also submitted because the Company are under an obligation to supply with water another village between the town and lake. The Inspector visited the works at the close of the inquiry.

Slot-Meter Consumers at Stafford.—At the monthly meeting of the Stafford Town Council on Tuesday, the Gas and Electricity Committee reported that, after having considered the proposal to allow a discount to the slot-meter consumers, they could not recommend any alteration. Alderman Wright, in submitting the report, said the Committee had obtained statistics from 25 towns similar to theirs, and in every case they found that the charge for gas to prepayment consumers was higher than at Stafford. He pointed out that every consumer of this class entailed an initial expense of £3 8s. 5½d. more than the ordinary consumer, and there was received back 2s., or about 3 per cent. Consequently, they thought it would be unfair to reduce the price to the former consumers, unless there could be a general reduction. Mr. Swift considered that the slot-meter consumer was entitled to some consideration; and he moved that the paragraph be referred back to the Committee. In the discussion which followed, it was pointed out that the prepayment consumers already had many concessions which were denied to the ordinary consumers of gas. Ultimately the report was adopted.

Water-Works Purchase Question at Mexboro'.—The Mexboro' Urban District Council have agreed to a recommendation of their Special Water Committee to offer to the local Water Company the sum of £11,917 inclusive, as the purchase price of their undertaking. This is the value placed upon the concern by Mr. W. Terrey, who was called in to advise the Council. On this basis, Mr. Terrey calculates that there will be a surplus of £146 at the end of the first year's working. It is proposed to borrow £14,000.

Preservation of Underground Water.—The Underground Water Preservation Association at their second annual meeting, held recently, reported that with an average percolation of 7 to 8 inches, and with a percolation of 24 inches for 1903, they had, for an average year, 250,000 to 300,000 gallons per diem for every square mile passing to the underground reservoir. Last year this figure must have been from 750,000 to 1,000,000 gallons daily for every square mile as an average throughout the twelve months. Notwithstanding the unprecedented rainfall and percolation of 1903, the water levels had not been restored to the height they occupied in former periods of wet weather. The overflow of the Orpington Gravel Pits had always been considered an indication of a large quantity of water in the ground; and records of this overflow had been kept for the last hundred years. Since 1840, these pits had overflowed at least five times. At present, with the added excessive percolation of this year, the level of the water in the pits was still far from the surface. That the deficiency has not been repaired, or anything approaching it, was evident from the fact that the level of the water in many wells had not risen to any substantial degree, and was still lower than it was twenty or thirty years ago. It was the opinion of residents and millowners in the neighbourhood of the Rivers Cray and Darenth, that, in spite of the excessive rains, the rivers were much lower than they were twenty years ago, and carried less water. Springs which had broken out in the valley of the Cray were already slackening, and levels were again falling. The chemical composition of water was also a matter which was being fully considered by the Association, more especially in regard to the infiltration of Thames and brackish water along the low-lying lands of the Thames Valley. For the purpose of this investigation, numerous samples had been taken and analyzed. Wells sunk to a depth of 300 feet with a shield for the first 200 feet in the locality of the marshes between Plumstead and Erith yielded very bad water, and, at a depth of 180 feet, with a shield reaching down 90 feet, the water pumped from the chalk contained 25 per cent. of river water. The brackishness of the water was bound to be increased as the levels were depressed by pumping. The effects of infiltration might extend half-a-mile or more as the levels were lowered, rendering the water supply, even at this distance, entirely unfit for drinking purposes. The pollution of one source of supply was attributed to the use of dried-up wells as cesspits—a practice highly condemned. The thanks of the meeting were given to the Executive Committee for their services; and it was resolved to continue, through the Committee, to take all necessary steps to further the objects of the Association.

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LONG LIFE.
RESULTS BETTER THAN HORIZONTALS.
LOW COST—WITH EFFICIENCY.

NEW CONVEYOR Co., Ltd., SMETHWICK.

Gas at the St. Louis Exhibition.—Writing on the above subject in "Progressive Age," Mr. F. R. Persons makes the following remarks: One of the most interesting and comprehensive exhibits in the Palace of Liberal Arts at the Louisiana Purchase Exposition at St. Louis is that of the Western Gas Association, which occupies space in the exact centre of the floor. It is the first time that a complete technical display of gas apparatus has been made at a World's Fair in America; and the Association has been very successful in its efforts to provide an exhibit that would properly represent the industry—the apparatus shown having been collected from all parts of the United States and England. The developments in the apparatus for using gas are being shown by exhibiting side by side the crude devices which were first employed and the present improved ones. The evolution of the gas-burner is shown in this way—every sort of a burner being exhibited, from the original models up to those of the present day. The development of arc lights, gas stoves, furnaces, meters, valves, and the system of laying mains, are all exhibited in the same way. Gas has been piped to all parts of the booth; and all the burners, stoves, &c., are shown in actual operation. Some of the latest improvements in gas apparatus that have not yet come into common use are exhibited. The latest model of a station meter is shown; a retort charging machine operated by electric power; new models of prepayment meters; new street-lamps; and chemical apparatus for testing gas which is the most up-to-date in the world. Several articles of historic value add a little sentiment to the exhibit. An old oscillating engine which was used in pumping water for the New Orleans Gas-Works some 70 years ago is shown, as well as several other ancient and most curious machines. The crowning feature of the exhibit is an exact reproduction of the Government lighthouse at South-West Pass, Louisiana, which stands at the most southern point of land of the Louisiana Purchase, and is a beacon-light for vessels on both the Mississippi River and the Gulf of Mexico—throwing its beams up through the Mississippi Valley, the natural gateway to the territory included in the Purchase. This old lighthouse was among the first erected by the Government in the territory, and has been in continual use ever since. The original is 125 feet high, and the reproduction is exactly one-fourth the actual size in every detail. Gas lamps of 2000-candle power are used in the model, and several sea gulls have been so mounted that they appear to be circling about the lamp. The model is painted a dark red with green blinds to the cabin windows; and is in every way a replica of the original tower.

Among catalogues recently to hand are one from Messrs. Henry Greene and Sons, Limited, of their gas-fittings, &c., and another from Messrs. Fletcher, Russell, and Co., Limited, which relates to gas cooking and heating appliances.

It is announced that the inauguration of the new water-works at Ilfracombe will take place on the 27th prox. The ceremony will be performed by Viscountess Ebrington, who will be supported by the Lord Lieutenant of the County of Devon (Viscount Ebrington).

We are pleased to learn that Mr. J. W. Hall, traveller in the eastern and southern districts for Messrs. John Wright and the Eagle Range, Limited, who was recently granted a month's leave of absence, in order that he might take a sea voyage for the benefit of his health, has now returned fit and well, and has resumed his business duties.

Messrs. Robert Dempster and Sons, Limited, of Elland, have received an order from the Cleethorpes Gas Company for a gasholder 118 feet diameter by 30 feet deep, and steel tank for same. The work has to be completed ready for next autumn, and is to be carried out under the supervision of Mr. E. J. Brockway, the Company's Engineer and General Manager.

Messrs. Falk, Stadelmann, and Co. have issued a *brochure* dealing with their "Veritas" mantles, which contains some interesting particulars regarding the use of ramie, of which the mantles are manufactured. Many advantages are claimed by the firm for this substance over any other of which incandescent mantles are made; and these are fully set forth in the pamphlet.

At their meeting on Tuesday, the London County Council agreed, on the recommendation of the Finance Committee, to advance to the Marylebone Borough Council, for the purposes of electric lighting, the sum of £1,415,000, on or before the 30th of October next, upon terms and conditions to be hereafter determined, and subject to the passing of the Borough Council's Electric Lighting Bill and of the County Council's Money Bill.

A special meeting of the Bradford Water Committee was held last Tuesday, to consider the salary of the Engineer, Mr. James Watson. It was stated that Mr. Watson had applied for the position of Engineer to the Metropolitan Water Board, the salary attaching to which was £2500 a year; and the Committee deemed it advisable to call a special meeting to see what could be done to keep him in Bradford to complete the Nidd Valley and Angram water-works extension schemes. The matter was discussed at great length; and it was pointed out that whereas thirteen years ago Mr. (now Sir Alexander) Binnie, received £1200, Mr. Watson's salary was at present £1250, while the work had more than doubled. It was resolved to recommend that an advance of £500 a year be offered to Mr. Watson. It is stated that, in consequence of this decision, Mr. Watson has withdrawn his application for the position of Engineer to the Metropolitan Water Board.

For some time time past, the Great Northern Railway Company of Ireland have contemplated improving the lighting arrangements of their locomotive works at Dundalk, and they were rather inclined to favour electricity; but Mr. G. Airth, the Manager of the local Gas Company, induced them to try a small installation of the Keith light some eighteen months ago. This proved so satisfactory that the Railway Company have now instructed him to light a large portion of the works by this system. The plant is to consist of one of Keith's patent No. 4 power-driven compressors, operated by a small gas-engine, and a number of 300 and 150 candle suspended globe reflector fittings; the whole equalling 33,000-candle power. This plant when fixed, will make the second large installation of the Keith light on the Railway Company's system, as the James Keith and Blackman Company some time ago were instructed to light the whole of their Belfast Station.

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APPLICATIONS FOR LETTERS PATENT.

12,194.—Sharp, W., "Lamps." May 30.
12,221.—Deschamps, J., "Gas-producers." May 30.
12,242.—Winkler, H., "Incandescent lamps." May 30.
12,251.—Delamarre, H. M. H., "Incandescent lamps." May 30.
12,297.—Smith, J. A., "Acetylene generators." May 31.
12,342.—Buck, J., and Them, H., "Acetylene generators." May 31.
12,361.—Tobiansky, L., "Gas-producers." May 31.
12,377.—Wolfson, J., "Flame spreaders." May 31.
12,403.—Helps, G., "Bunsen-burner tubes for inverted mantles." June 1.
12,413.—Keith, J. & G., "Gas-compressors." June 1.
12,462.—Still, W. M. & E. H., "Pressure-reducing valves." June 1.
12,609.—Davies, S. R., "Fixing gas-adapters." June 3.
12,658.—Redman, T., "Gas-valves." June 4.
12,659.—Redman, T., "Gas-washers." June 4.
12,672.—Helps, G., "Clips for mains." June 4.
12,702.—Still, W. M. & E. H., "Pressure-reducing valves." June 4.
12,851.—Buckley, W. W., "Gas-cocks." June 7.
12,853.—Platts, H., and Clarke, H. P., "Inverted incandescent lamps." June 7.
12,854.—Robel, G., "Mantles." June 7.
12,880.—Melhuish, A. G., "Internal combustion engines." June 7.
12,946.—Turner, E., "Acetylene burners." June 8.
12,986.—Torda, T., and Bornand, V., "Photometers." June 8.
13,004.—Skriwan, H., and Lenner, A., "Mantle supports." June 8.
13,009.—Worringen, E., "Gas igniters." June 8.
13,088.—Harrison, H. T., "Illumination of streets." June 9.
13,102.—Milne, J., "Meters." June 10.
13,108,—Clayton, R., and Whitehouse, E., "Heating and lighting." June 10.
13,188-9-90.—Westinghouse, G., "Turbines." June 10,
13,236.—Sheldrake, J. H., "Washer-scrubbers." June 11.
13,245.—Knopf, A., and Mindsent, B., "Inverted incandescent lamps." June 11.
13,271.—Cherry, T. W. F., "Producer gas cleansing plant. June 11.
13,272.—Cherry, T. W. F., "Gas plant for propulsion of ships." June 11.

WANTED, FOR SALE, CONTRACT, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Situations Vacant.

Manager. Horncastle Gas-Works. Applications by July 6.
Draughtsman. Drakes Limited, Halifax.
Assistant. Nuneaton Gas-Works.
Representative. "Refractory," care of Streets Cornhill.
Assistant Traveller. No. 4223.
Fitter. Dorking Gas Company.
Foreman Fitter. Sunderland Gas Company.
Foreman Gas Fitter and Outdoor Work. No. 4225.
General Working Foreman. Ascot Gas Company.

Situation Wanted.

Accountant or Chief Clerk. No. 4220.

Plant, &c., for Sale.

Gasholder and Part of Tank. Uxbridge and Hillingdon Gas Company.
Purifiers. Neston Gas-Works.

Company Meetings.

Kent Water Company. Cannon Street Hotel, July 6, 11 o'clock.

Stocks and Shares for Sale.

East Surrey Water Company. June 22.
North Middlesex Gas Company. July 5.
Reigate Gas Company. June 22.
Sevenoaks Water Company. July 23.

TENDERS FOR

Brass and Gun Metal Taps and Fittings, Pendants, &c.

Salford Gas Department. Tenders by July 7.

Carbon.

Charlesworth and Co., Wakefield. No. 4224.

Coal and Cannel.

Accrington Gas and Water Board. Tenders by June 28.
Bolton Gas Department. Tenders by June 30.
Bradford Gas Department. Tenders by July 13.
Carlisle Gas Department. Tenders by June 27.
Colwyn Bay and Colwyn Gas Department. Tenders by June 29.
Exmouth Gas Company. Tenders by July 2.
Haworth Urban District Council. Tenders by June 30.
Holyhead and North Wales Gas and Water Corporation. Tenders by June 29.
Ilkeston Gas Department. Tenders by July 5.
Keswick Gas Company. Tenders by June 22.
Malton Gas Company. Tenders by July 2.
Newport (Mon.) Gas Company. Tenders by July 4.
Northwich Gas Company. Tenders by June 24.
Ossett Gas Department. Tenders by June 27.
Radcliffe and Pilkington Gas Company. Tenders by June 29.
St. Annes-on-the-Sea Gas Company. Tenders by June 29.

Coke.

Ossett Gas Department. Tenders by July 1.

Fire-Clay Goods.

Carlisle Gas Department. Tenders by June 27.

General Stores, Ropes, Paints and Oils, Rubber Tubing, &c.

Salford Gas Department. Tenders by July 7.

Iron and Steel, and Castings.

Salford Gas Department. Tenders by July 7.

Lime.

Congleton Gas Department. Tenders by July 2.

Meters and Fittings.

Salford Gas Department. Tenders by July 7.

Pipes and Specials, &c.

Glasgow Gas Department. Tenders by June 28.
Salford Gas Department. Tenders by July 7.

Tar and Ammoniacal Liquor.

Atherton Gas Department. Tenders by June 22.
Congleton Gas Department. Tenders by July 2.
Croydon Gas Company. Tenders by July 1.
Guildford Gas Company. Tenders by June 29.
Hanwell Asylum. Tenders by July 2.
Keswick Gas Company. Tenders by June 22.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office NOT LATER than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

Wanted, For Sale, and Tender Advertisements, Six Lines and under, 3s.; each additional Line, 6d.

TERMS OF SUBSCRIPTION to the "JOURNAL."

United Kingdom: One Year, 21s.; Half Year, 10s. 6d.; Quarter, 6s. 6d.
Payable in Advance. If credit is taken, the charge is 25s. a year.
Abroad (in the Postal Union): £1 7s. 6d., payable in Advance.

All Communications, Remittances, &c., to be addressed to Walter King, 11, Bolt Court, Fleet Street, London, E.C.
Telegrams: "GASKING, LONDON." Telephone: P.O. 1571a Central.

OXIDE OF IRON.

O'NEILL'S OXIDE has a larger annual sale than all other Oxides combined.

SPENT OXIDE purchased in any district.

GAS PURIFICATION & CHEMICAL CO., LD.

John Wm. O'Neill, Managing Director,

Palmerston House, London, E.C.

WINKELMANN'S

"VOLCANIC" FIRE CEMENT.
Resists 4500° Fahr. Best for GAS-WORKS.
Andrew Stephenson, 182, Palmerston House, Old Broad Street, London E.C. "Volcanism, London."

BROTHERTON & CO., LIMITED.
Offices: Commercial Buildings, Leeds.
Correspondence invited.

SPENT OXIDE.

THE South Metropolitan Gas Company are always open to receive OFFERS of SPENT OXIDE.
Chief Office: 709, Old Kent Road, London, S.E.
Telegrams: "Metrogas, London."

SULPHURIC ACID for Sale, specially suitable for making Sulphate of Ammonia.
Brotherton and Co., Ltd., Chemical Manufacturers.
Works: Birmingham, Leeds, and Wakefield.

J. & J. BRADDOCK (Branch of Meters Limited), Globe Meter Works, Oldham, and 45 & 47, Westminster Bridge Road, London, S.E.
WET AND DRY GAS-METERS, PREPAYMENT METERS, STATION METERS, AND GOVERNORS.
Repairs receive prompt attention.
Telephones: 254 Oldham, and 2412 HOP, London.
Telegrams:—
"Braddock, Oldham," and "Metrique, London."

DUTCH OXIDE OF IRON.

THE First Dutch Bog Ore Co., Ltd., (Eerste Hollandsche Yzererts Maaty), ROTTERDAM.
General Manager (for England and Wales)—
CHARLES E. FRY, LEAMINGTON; and at Tower Chambers, Brown Street, Manchester.
London Managers—
E. PADFIELD & CO., 96-98, Leadenhall Street, LONDON, E.C.
General Manager (for Scotland)—
J. B. MACDERMOTT, 11, Bothwell St., GLASGOW.

PENNY-IN-THE-SLOT WORK.

H. GREENE & SONS, Ltd., are pre- pared to give QUOTATIONS to Gas Companies or Corporations for FITTING UP COMPLETE and CARRYING OUT the WORK in its entirety, either in Iron or Compo.
Surrey Engineering Works, Blackfriars Road, London, S.E.
Telephone: 1693 Hop. Telegrams: "Luminosity."

OXIDE OF IRON.
(NATURAL.)

BALE & CHURCH will be pleased to send Samples and Quotations, and make Offers for SPENT OXIDE.
BALE'S FIRE CEMENT, PAINT, AND GAS COAL
5, Crooked Lane, London, E.C.

AMMONIACAL LIQUOR wanted.
Brotherton and Co., Ltd., Ammonia Distillers.
Works: Birmingham, Leeds, and Wakefield.

PATENTS AND TRADE MARKS
PUBLICATIONS. "MERCHANDISE MARKS ACT, and Decisions thereunder," 1s.; "TRADE SECRETS v. PATENTS," 6d.; "DOCTRINE of EQUIVALENTS, Mechanical and Chemical," 6d.; SUBJECT-MATTER of PATENTS," 6d.
MEWBURN, ELLIS, & PRYOR, Chartered Patent Agents, 70 and 72, Chancery Lane, London, W.C. Telegrams: "Patent London." Telephone: No. 243 Holborn.

GAS TAR wanted.
Brotherton and Co., Ltd., Tar Distillers.
Works: Birmingham, Leeds, and Wakefield.

HYDRATED OXIDE OF IRON.

PREPARED from Pure Iron.
Twice as Rich as Bog Ore.
Gives no Back Pressure.
The Cheapest in the Market.
Can be Lent on Hire.
Can be Exchanged for Spent Oxide.
Read Holliday and Sons, Ltd., Huddersfield.

THE KEITH LIGHT.

OVER 1600 INSTALLATIONS IN DAILY USE.

SEE illustrated advertisement in next week's issue.

JAMES KEITH AND BLACKMAN, CO., LTD., 27, Farringdon Avenue, LONDON, E.C.

SULPHURIC ACID.

SPECIALLY prepared for the Manufacture of SULPHATE OF AMMONIA.

SPENCER, CHAPMAN, AND MESSEL, LIMITED, 36, Mark Lane, LONDON, E.C. Works: SILVERTOWN.

Telegrams: "HYDROCHLORIC, LONDON."

Telephone: 341 AVENUE.

AMMONIACAL Liquor wanted by JOHN RILEY & SONS, Hapton, near ACCRINGTON.

TO GAS AND WATER OFFICIALS.

MELROSE CYCLES and Slot Copper COLLECTORS. Latest Design and lowest Prices. For Cash or gradual payments. Catalogue free.

MELROSE CYCLE COMPANY, COVENTRY.

COAL GAS TAR wanted.

BEST PRICES GIVEN.

SHARPNESS CHEMICAL COMPANY, LIMITED, Sharpness Docks, GLOS.

"NUGEPE" CEMENT.

JOHN E. WILLIAMS AND CO.,

VICTORIA PAINT WORKS,

MANCHESTER.

For all Joints in connection with Oil-Gas Plant and Sulphate Plant.
For all Gas Joints.
For all Tar Joints.
For all Ammonia Joints.

COAL GAS TAR wanted.

ROBINSON BROTHERS, LIMITED. Works: WEST BROMWICH, KNOTTINGLEY, and SPONDON.

SULPHATE OF AMMONIA

SATURATORS and LEAD WORK for Sulphate of Ammonia Plants.

For REPAIRS or ALTERATIONS, ring up "0848 BOLTON," or Telegraph "SATURATORS, BOLTON."

Largest Practice and most Up-to-Date Works in Britain.

JOSEPH TAYLOR AND CO., CENTRAL PLUMBING WORKS, BOLTON.

APPOINTMENT Wanted as AccountANT or CHIEF CLERK in a Gas or Gas and Water office. Over Twelve Years' Experience. First-class Testimonials.

Address No. 4220, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Draughtsman accustomed to Elevating and Conveying Machinery. Must have good Experience. Good Salary to suitable man.

Apply, by letter, to DRAKES LIMITED, HALIFAX.

ASSISTANT Wanted, well up in Mathematics and Chemistry, and a fair Draughtsman. The position will not suit a Musician or a proficient Bridge player.

Apply to G. HELPS, Gas-Works, NUNEATON.

GAS-STOVE TRADE.

ASSISTANT Traveller required. Exceptional prospects for a really good man.

Apply, by letter, stating Age, Experience, and Qualifications, to No. 4223, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Man capable of Controlling Gas-Fitters and all Out-Door work in connection with a provincial Gas Company. Wages to commence with £2 per week.

Address, giving Age, and Experience, to No. 4225, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED by the Dorking Gas Company, a thoroughly Competent FITTER to Fit Houses for Gas and Lay Mains and Services. Wages 33s. per week and Commission for new Consumers.

Smart, Energetic Candidates may apply, by Letter, to the MANAGER, stating Age, and enclosing Testimonials or References.

ASCOT DISTRICT GAS COMPANY.

WANTED, at once, a thoroughly efficient GENERAL WORKING FOREMAN, who must have full knowledge of the whole routine of a Gas-Works, be a good Carbonizer, and capable of undertaking repairs, Laying of Mains and Services, and of Controlling Workmen. A practical knowledge of the Manufacture of Sulphate of Ammonia would also be desirable.

He must be sober and steady, and able to take entire charge of the Works in the absence of the Manager.

Wages to commence at £2 per week, with House, Gas, and Coals free.

Apply with *copies* of Three recent Testimonials, stating present Position and Age, to

A. E. BROOKS,
Manager.

Gas-Works, Sunninghill,
Berks., June 20, 1904.

ROBERT DEMPSTER & SONS, Ltd.,

Contractors for Complete CARBONIZING PLANTS and every description of GAS APPARATUS and ELEVATING and CONVEYING PLANT, ROSE MOUNT IRON-WORKS, ELLAND.

REPRESENTATIVE wanted for the sale of Special Refractory Cement for Gas-Retorts and other Gas-Works purposes. Must have necessary Connection and be a pushing Salesman.

Apply, with full Particulars, References, Age, and Terms expected, to "REFRACTORY," care of Street's, 30, CORNHILL, E.C.

SUNDERLAND GAS COMPANY.

WANTED, a Foreman Fitter for the Company's Hendon Gas-Works. He must have had a thorough Mechanical Training and possess a good Practical Knowledge of Gas Plant, including Power Stoking Machinery. Preference given to one occupying a similar position. Age 30 to 40. Wages 48s. per week.

Apply, by letter, in own hand-writing, stating Experince, whether Married or Single, and enclosing *copies* of not more than Three Testimonials, to The MANAGER, Hendon Gas-Works, SUNDERLAND.

HORNCASTLE URBAN DISTRICT COUNCIL GAS-WORKS.

THIS Council are prepared to receive APPLICATIONS for the post of MANAGER of their Gas-Works.

Salary, £120 per annum, with House, Coals, and Gas.

Applicants not to be under the Age of 25 or over 40.

Applications, in Candidates own hand-writing, endorsed "Gas Manager," stating Qualifications and previous Experience, with *copies* of not less than Three recent Testimonials, must be sent in so as to reach me on or before Wednesday, the 6th day of July next.

The Candidate appointed must give satisfactory Security for the discharge of his duties, devote the whole of his time to the work, and will be required to enter on his duties on the 1st day of September, 1904.

H. TWEED,
Clerk to the Council.

6, Lindsey Court, Horncastle,
June 17, 1904.

FOR SALE—Ten Tons of good Carbon.

Apply to Messrs. J. & J. CHARLESWORTH, LIMITED, Milnes House, WAKEFIELD.

CARBON (over 4 Tons) in Glamorgan.

Offers invited to No. 4224, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

FOR SALE—Two 6 feet by 6 feet PuriFIERS, by Dempster, with two Four-Way Valves. Replaced by larger

Apply to A. E. ASHLEY, Manager, Gas-Works, NESTON.

GAS PLANT for Sale—I can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. Compare Prices and Particulars before ordering elsewhere.

J. F. BLAKELEY, Gas Engineer, Thornhill, DEWSBURY.

GASHOLDER, 40 ft. diameter by 14 ft. deep, in wrought Tank, with six Columns, trellis Girders, and Suspension Gear. In splendid condition. Nearly new.

New GASHOLDER, 40 ft. diameter by 12 ft. deep, with Steel Standards; also new STEEL TANK to contain same.

Write J. WRIGHT, 181, Queen Victoria Street, LONDON, E.C.

UXBRIDGE AND HILLINGDON GAS COMPANY.

GASHOLDER FOR SALE.

TO GASHOLDER MAKERS AND OTHERS.

THE Company invite Offers for Cast-Iron COLUMNS, FRAMING, BELL (2 Lifts), and part Cast-Iron TANK OF HOLDER, 55,000 cubic feet capacity. Tank 18 ft. deep by 47 ft. diameter. Half the latter for sale. Suit small Company admirably.

All further Particulars from

A. R. BURCH,
Engineer and Manager.

EXMOUTH GAS COMPANY.

THE Directors of the Exmouth Gas Company invite TENDERS for the supply of 4500 to 5000 Tons of Best GAS COAL (screened or unscreened) to be delivered in such quantities and at such times as may be required from the 1st of August, 1904, to the 31st of July, 1905, and to weigh 20 cwt. to the Ton over the Gas Company's or Dock Company's weighbridge (the said machines are regularly inspected by the Officer under the Weights and Measures Act), the Coal to be fresh wrought, dry, and free from Hards, Smudge, Dirt, Shale, and Pyrites.

Tenders to be accompanied by practical working analysis. Prices may be quoted c.i.f. or f.o.b. Exmouth Docks, or f.o.r. Exmouth Railway Station (L. & S.W. Railway).

Sealed Tenders, endorsed "Tender for Coal," to be addressed to J. Palmer, Esq., Chairman, and delivered to the undersigned not later than Saturday, the 2nd day of July, 1904.

The Directors do not bind themselves to accept the lowest or any Tender.

Forms of Tender are not supplied.

JAMES T. FOSTER,
Secretary and Manager.

Gas-Works, Exmouth,
June 9, 1904.

LONDON COUNTY ASYLUM, HANWELL, W.

THE Sub-Committee for the control and Management of the above-named Asylum are prepared to receive OFFERS for the purchase of TAR and AMMONIACAL LIQUOR for the Twelve Months ending June 30, 1905.

Terms, Cash on removal.

Forms of Tender, with estimated quantities for Sale, may be obtained on application to the Resident Engineer at the Asylum.

Tenders must be sent, in sealed covers, endorsed "Tender for Tar and Liquor, Hanwell Asylum," to the undersigned by or before Ten o'clock a.m. on Saturday July 2, 1904.

The Sub-Committee do not bind themselves to accept the highest or any Tender.

R. W. PARTRIDGE,
Clerk of the Asylums Committee.

London Asylums Committee Office,
6, Waterloo Place, London, S.W.
June 15, 1904.

ST. ANNES-ON-THE-SEA GAS COMPANY.

TENDERS are invited for the supply of 2000 to 4000 Tons of best screened GAS COAL, to be delivered at St. Annes on-the-Sea as required during the Year ending June 30, 1905.

Sealed Tenders, endorsed "Coal," to be delivered at the Company's Office on or before Wednesday, June 29 inst.

No special Form of Tender issued.

WILLIAM H. NUTTER,
Secretary and Manager.

Gas Offices, St. Annes-on-the-Sea,
June 13, 1904.

BOROUGH OF OSSETT.

(GAS DEPARTMENT.)

TENDERS FOR COAL.

THE Ossett Corporation Gas Committee are prepared to receive TENDERS for 8500 Tons of screened GAS COAL for One Year, or 17,000 Tons for Two Years.

Specifications and Forms of Tender may be had on application to Mr. Arnold E. Mottram, Engineer and Manager.

Tenders, marked "Tender for Coal," to be sent in to me, the undersigned, not later than the 27th inst.

W. BROOK,
Town Clerk.

Borough Offices, Ossett,
June 15, 1904.

BOROUGH OF OSSETT.

(GAS DEPARTMENT.)

TENDERS FOR COKE.

THE Ossett Corporation Gas Committee invite TENDERS for the surplus COKE, for One Year, from the 1st of July next.

Particulars may be had on application to Mr. Arnold E. Mottram, Engineer and Manager.

W. BROOK,
Town Clerk.

Borough Offices, Ossett,
June 15, 1904.

CITY OF CARLISLE.

THE Carlisle Gas Committee are prepared to receive TENDERS for the COAL and CANNEL required at their Works during One Year from the 1st of July next.

Tenders, endorsed "Coal," and addressed to the Chairman of the Gas Committee, to be delivered at the office of the Town Clerk, not later than June 27, 1904.

Forms of Tender and other Particulars may be had on application to the undersigned.

By order.
W. J. SMITH,
Engineer and General Manager.

Gas-Works, Carlisle,
June 7, 1904.

CITY OF CARLISLE.

THE Carlisle Gas Committee are prepared to receive TENDERS for the FIRE-CLAY, RETORTS, BRICKS, &c., required at their Works during One Year from the 1st of July next.

Tenders, endorsed "Fire-Clay," and addressed to the Chairman of the Gas Committee, to be delivered at the office of the Town Clerk not later than June 27, 1904.

Form of Tender, giving quantities, &c., will be forwarded on application.

By order,
W. J. SMITH,
Engineer and General Manager.

Gas-Works, Carlisle,
June 7, 1904.

AMENDED ADVERTISEMENT.

BOROUGH OF CONGLETON.

THE Gas Committee invite Tenders for the following:—

1.—TAR AND AMMONIACAL LIQUOR.

The purchase of TAR and AMMONIACAL LIQUOR which will be produced during the Twelve Months ending June 30, 1904.

Form of Tender and Conditions may be obtained from the undersigned.

2.—LIME.

The supply of about 120 Tons of Best Hand-Picked LIME for Purifying Purposes, to be delivered in Sender's or Railway Company's Trucks at Brunswick Wharf, Congleton, at such times as may be required during the Twelve Months ending June 30, 1904.

No special Form required.

Tenders, endorsed "Tar" and "Lime" respectively, to be delivered at the Office of E. A. Plant, Esq., Town Clerk, Congleton, on or before Saturday, the 2nd day of July, 1904.

The Committee do not bind themselves to accept the lowest or any Tender.

JAMES SMITH,
Engineer and Manager.

THE HOLYHEAD AND NORTH WALES GAS AND WATER CORPORATION, LIMITED.

TENDERS FOR COAL.

THE Directors of the above Company are prepared to receive TENDERS for the Supply and Delivery of COALS to their various works for the ensuing Year.

Full Particulars and Forms of Tender may be had on application to the undersigned, and no Tender will be considered except on the official Form.

Sealed Tenders, endorsed "Tender for Coal," must be sent not later than Wednesday, June 29, 1904.

GEORGE E. SAVILLE,
Managing Director.

Penmaenmawr,
June 18, 1904.

THE Directors of the Croydon Gas Com- pany invite TENDERS, at a fixed price per gallon, for the purchase of their surplus COAL-GAS TAR during the Twelve Months ending June 30, 1905, delivered free into Contractor's Tank-Waggons at their Sidings, Waddon Marsh, Croydon.

They also invite alternative Tenders on the Sliding-Scale basis, particulars of which may be obtained from the undersigned.

Tenders, endorsed "Tender for Tar," and addressed to the Chairman and Directors of the Croydon Gas Company, Katharine Street, Croydon, to be delivered not later than Nine a.m. on Friday, July 1, 1904.

The Directors do not bind themselves to accept the lowest or any Tender.

JAMES W. HELPS,
Engineer and General Manager.

June 18, 1904.

CORPORATION OF ILKESTON.
(GAS DEPARTMENT.)

THE Gas Committee invite Tenders for 10,000 Tons of GAS COAL, NUTS, or CANNEL, to be delivered as required at the Gas-Works Siding, Midland Railway.

The Tenders must be on the usual Forms, which are to be had on application at the Gas Office.

Sealed and endorsed Tenders to be sent to Wright Lissett, Esq., Town Clerk, not later than July 5, 1904.

The Committee do not pledge themselves to accept the lowest or any Tender, and reserve their right to divide the quantity.

F. C. HUMPHRYS,
Engineer and Manager.

Gas-Works, Ilkeston,
June 18, 1904.

URBAN DISTRICT COUNCIL OF COLWYN BAY AND COLWYN.
(GAS DEPARTMENT.)

THE above Council invite Tenders for the supply of approximately 4500 Tons of best screened GAS COAL, to be delivered during the Twelve Months ending June 30, 1905, as required, free at Colwyn Bay Station.

Sealed Tenders, stating price per Ton, and endorsed "Tender for Coal," to be sent in, addressed to the undersigned, on or before Wednesday, the 29th inst.

Further Particulars on application to the Engineer and Manager, Mr. J. C. Pennington.

The Council do not bind themselves to accept the lowest or any Tender, and reserve the right to purchase any portion of the quantity offered.

By order,
JOS. H. ROBERTS,
Clerk.

Council Offices, Colwyn Bay,
North Wales, June 7, 1904.

ACCRINGTON DISTRICT GAS AND WATER BOARD.

THE Board are prepared to receive TENDERS for the supply of about 30,000 Tons of best screened GAS COAL, Washed NUTS, and Washed BEANS, to be delivered at the Gas-Works, Accrington, and the Gas-Works, Great Harwood, between the date of the Contract and the 30th of June, 1905, in such quantities and at such times as may be ordered by the General Manager of the Board.

Tenders will be received for 10,000, 20,000, or 30,000 Tons, but not for a less quantity than 10,000 Tons.

Tenders, to be sealed and addressed to the Chairman of the Board, must be in my hands on or before Tuesday, the 28th of June.

The Board do not bind themselves to accept the lowest or any Tender.

By order of the Board,
CHARLES HARRISON,
General Manager.

General Offices, Accrington,
June 13, 1904.

CITY OF BRADFORD.

TO COLLIERY PROPRIETORS AND OTHERS.

THE Gas Committee of the Bradford Corporation are prepared to receive TENDERS for the supply of best GAS COAL, COBBLES, NUTS, and CANNEL, all to be well screened, dressed, and free from Shale and Pyrites, to be delivered at the several Works of the Corporation during the period of One Year, commencing on the 1st day of August next.

Form of Tender, with any further Information required, may be had on application to Mr. Chas. Wood, Gas Engineer, Town Hall.

Sealed Tenders, endorsed "Tender for Coal," to be sent to me on or before Wednesday, the 13th of July next.

The Contracts will be let subject to the Fair Contracts Clauses of the Corporation, which may be seen at the Town Clerk's Office, and which the accepted Contractors will be required to sign.

The lowest or any Tender will not necessarily be accepted.

FREDERICK STEVENS,
Town Clerk.

Town Hall, Bradford,
June 13, 1904.

THE Directors of the Keswick Gas Company invite TENDERS for the supply of 1700 Tons of best screened GAS COAL, or NUTS, to be delivered at Keswick Railway Station, between the 1st of July, 1904, and the 30th of June, 1905, in such quantities and at such times as may be required.

Tenders, stating price per ton, endorsed "Tenders for Coal," to be sent to the undersigned not later than the 22nd inst.

The Directors do not bind themselves to accept the lowest or any Tender.

J. H. BRODIE,
Secretary.

Main Street, Keswick,
June 2, 1904.

THE Directors of the Keswick Gas Company invite TENDERS for their surplus TAR and AMMONIACAL LIQUOR, for Twelve Months from the 30th inst., at per ton delivered into Contractor's Tanks at Keswick Railway Station.

Sealed Tenders, endorsed "Tenders for Tar or Liquor," will be received by the undersigned on or before Wednesday, the 22nd inst.; but the Directors do not bind themselves to accept the highest or any Tender.

J. H. BRODIE,
Secretary.

Main Street, Keswick,
June 2, 1904.

RADCLIFFE AND PILKINGTON GAS COMPANY.

TENDERS FOR COAL.

THE Directors invite Tenders for a Twelve Months supply of GAS COAL.

Particulars may be obtained from the undersigned, by whom Tenders will be received until Wednesday, the 29th inst.

JAMES BRADDOCK,
Manager and Secretary.

Gas Offices, Radcliffe,
June 15, 1904.

GLASGOW CORPORATION.
(GAS DEPARTMENT.)

TO IRONFOUNDERS.

THE Corporation of Glasgow are pre- pared to receive TENDERS for about 3200 Yards of 18-inch diameter CAST-IRON PIPES, with such SPECIAL CASTINGS as may be required.

Copies of the Specification and Form of Tender may be obtained on application to Mr. Alexander Wilson, Gas Engineer, at his Office, No. 45, John Street, Glasgow.

Sealed Offers, Marked "Gas Department—Tender for Cast-Iron Pipes," addressed to the Subscriber, will be received by him on or before Tuesday, the 28th curt.

The Corporation do not bind themselves to accept the lowest or any Tender.

JAMES G. MONRO,
Town Clerk.

City Chambers, Glasgow,
June 17, 1904.

NEWPORT (MON.) GAS COMPANY.

TENDERS FOR COAL.

THE Directors invite Tenders for the supply of about 32,000 Tons of best GAS COALS for the period of One Year from the 1st of August next, to be delivered on the Company's Sidings at their Mill Street or Crindau Works in such quantities and at such times as may be directed by the Company's Engineer, from whom further Information may be obtained.

Tenders will be received for the whole or part of the above quantity.

Tenders, endorsed "Coals," to be delivered at the Offices of the Company not later than Monday, July 4, 1904.

The Directors do not bind themselves to accept the lowest or any Tender.

By order,
T. H. HAZELL,
Secretary.

Newport (Mon.), June 17, 1904.

COUNTY BOROUGH OF SALFORD.
(GAS DEPARTMENT.)

GENERAL STORES.

THE Gas Committee invite Tenders for the following MATERIAL in such quantities as may be required during the Twelve Months ending the 31st of August, 1905:—

1.—Wrought-Iron and Steel.
2.—Lead Pipe, Block Tin Tubing, Pendants, and Glass.
3.—Bolts, Nuts, Rivets, and Washers.
4.—Iron Castings, &c.
5.—Gun Metal Taps and Keys, and Brass Lamp Taps.
6.—Wrought-Iron Steam and Gas Tubing, and Sundry Fittings.
7.—Gas-Meters.
8.—Paints, Red and White Lead.
9.—Oils and Tallow.
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11.—Rope, Yarn, and Twine.
12.—Brushes.
13.—Testing and Repairing Weighing Machines.
14.—Brass Fittings for Meters.
15.—India-Rubber Tubing, Sheeting, &c.
16.—Cast-Iron Main-Pipes.

Forms of Tender and all Information may be obtained, and samples seen, on application to Mr. Wm. W. Woodward, Engineer, Bloom Street, Salford.

Sealed Tenders, endorsed "Tender for Stores," addressed to the Chairman of the Gas Committee, Town Hall, Salford, to be delivered to me not later than Three p.m. on Thursday, the 7th of July, 1904.

L. C. EVANS,
Town Clerk.

Town Hall, Salford,
June 16, 1904.

TAR Contracts Wanted on the Sliding- Scale or at Fixed Prices.

Managers and Secretaries desirous of selling to best advantage please communicate with DENT AND CO., Ouse Chemical Works, SELBY.

GAS TAR.

THE Urban District Council of Atherton invite TENDERS for the purchase of the TAR produced at their Gas-Works during Twelve Months from the 30th of June inst.

Probable quantity about 400 Tons.

Sealed Tenders to be delivered to the undersigned on or before Wednesday, the 22nd. inst.

D. SCHOFIELD,
Clerk.

THE Haworth Urban District Council are prepared to receive TENDERS for the supply of 2500 Tons of GAS COAL (Screened, Unscreened, and Gas Nuts) delivered at Haworth Railway Station during the ensuing Twelve Months.

Sealed Tenders, endorsed "Gas-Coal Tender," may be forwarded to me the undersigned not later than the 30th inst.

WILLIAM ROBERTSHAW,
Clerk.

1, Burlington Chambers,
North Street, Keighley.

TENDERS FOR COAL.

THE Directors of the Malton Gas Com- pany are prepared to receive TENDERS for the supply of about 4500 Tons of D. S. GAS NUTS, to be delivered at Malton Station in the Twelve Months ending the 30th of June, 1905.

Particulars may be obtained of the undersigned.

Tenders to be sent in on or before Saturday, the 2nd of July next.

HENRY TOBEY,
Engineer and Secretary.

Malton, Yorks., June 18, 1904.

THE Directors of the Northwich Gas Company are prepared to receive TENDERS for the supply of about 6000 Tons of GAS COAL during the Year ending June 30, 1905.

Form of Tender and any other Particulars can be had on application to the undersigned.

Sealed Tenders, endorsed "Coal," and addressed to the Chairman, must be delivered here not later than Ten a.m. on Friday, June 24.

SAMUEL S. MELLOR,
Manager and Secretary.

Gas Offices, Northwich,
June 6, 1904.

COUNTY BOROUGH OF BOLTON.
(GAS DEPARTMENT.)

TENDERS FOR COAL.

THE Gas and Lighting Committee in- vite TENDERS for the supply of screened and unscreened GAS COAL, GAS SLACK, COBBLES, and NUTS required during the Year ending the 30th of June, 1905.

Specifications and Forms of Tender may be obtained on application to Mr. Wm. Walch, Office Superintendent, Gas Offices, Bolton.

Sealed Tenders, endorsed "Tender for Coal," and addressed to the Chairman of the Committee, to be delivered at the Gas Offices, Bolton, not later than Thursday, the 30th of June, 1904.

R. G. HINNELL,
Town Clerk.

Town Hall, Bolton,
June 13, 1904.

GUILDFORD GASLIGHT AND COKE COMPANY

TO TAR DISTILLERS.

THE Directors of the above Company are prepared to receive TENDERS for the surplus COAL-GAS TAR and CARBURETTED WATER-GAS TAR, separately or mixed, produced by the above Company, for the Year ending June 30, 1905.

Coal carbonized about 12,000 Tons per annum.

All Tenders to state the price per cask of 40 gallons.

Cartage to and from the Railway Station, Guildford, free. All empties to be provided by Contractor.

Tenders, endorsed "Tar," to be sent to William Baker, Esq., J.P.C.A., Chairman of the Gas Company, Guildford, on or before Wednesday, June 29, 1904.

By order,
WILLIAM TITLEY,
Secretary.

Gas-Offices, Guildford,
June 4, 1904.

KENT WATER-WORKS COMPANY.

NOTICE is Hereby Given, that an Ex- TRAORDINARY GENERAL MEETING of the Company of Proprietors of the Kent Water-Works will be held at the Terminus Hotel, Cannon Street, in the City of London, on Wednesday, the 6th day of July, 1904, at Eleven o'clock in the forenoon, for the purpose of considering, and, if thought fit, passing, a Resolution empowering the Directors to enter into an agreement on behalf of the Company with the Metropolitan Water Board for the discharge, either wholly or partly, in Water Stock of the compensation awarded to the Company for the transfer of their Undertaking.

By order of the Directors,
A. DICKSON, Junr.,
Chief Clerk and Secretary.

Mill Lane, Deptford,
June 17, 1904.

SEVENOAKS WATER-WORKS COMPANY.

NOTICE is Hereby Given, that the Sevenoaks Water-Works Company, in pursuance of their Provisional Order of 1900, as confirmed by Act of Parliament, being desirous of increasing their Capital, have resolved to issue

THREE HUNDRED AND FIFTY 4 PER CENT. PREFERENCE SHARES OF £10 EACH.

Tenders are Hereby Invited from the Public for the same, at not less than par value.

The present issue of capital is made to provide for an additional Pumping Plant, new Reservoirs, and new Mains at Seal Chart, Stone Street, and Bitchet.

The Company are now paying the maximum dividend on their Stock and Share Capital.

The Shares are payable as under—viz.:

£2 on Application,
£3 on Allotment,

and the Balance within Three Months of Allotment.

Tenders are to be addressed to the Company, at their Offices, Oak Lane, Sevenoaks, on or before the 23rd day of July, 1904, and endorsed "Tender for Shares."

Where no allotment is made, the deposit will be returned in full.

Forms of Tender on application at the Company's Offices.

By order of the Board,
ALFRED GRAINGER,
Secretary

Water-Works Offices, Oak Lane,
Sevenoaks, June 13, 1904.

ISSUES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his ISSUES by AUCTION under PARLIAMENTARY POWERS of STOCKS and SHARES in LONDON, SUBURBAN, and PROVINCIAL GAS and WATER COMPANIES take place PERIODICALLY at the Mart, TOKENHOUSE YARD, E.C.

Terms for Issuing such Capital, and also for including Gas and Water Stocks and Shares belonging to Private Owners in these Periodical Sales, can be obtained on application at MR. ALFRED RICHARDS' OFFICES, 18, FINSBURY CIRCUS, E.C.

By Order of the Directors of the

NORTH MIDDLESEX GAS COMPANY.

NEW ISSUE OF £3000 FOUR PER CENT.

PERPETUAL DEBENTURE STOCK.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, July 5, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

SALE WEDNESDAY NEXT.

By order of the Executors.

REIGATE GAS COMPANY.

£2130 ORDINARY STOCK and 119 £10 SHARES (£5 paid).

MAPLE & CO. have received Instructions from the Executors of the late Richard Kelsey, Esq., to SELL the above BY AUCTION, at Laker's Hotel, Redhill, on Wednesday, June 22, 1904, at Six o'clock.

Particulars of the AUCTIONEERS, 109, King's Road, BRIGHTON, LONDON, and EASTBOURNE.

SALE WEDNESDAY NEXT.

By order of the Executors.

EAST SURREY WATER COMPANY.

£4250 PREFERENCE STOCK.

MAPLE & CO. have received instructions from the Executors of the late Richard Kelsey, Esq., to SELL the above BY AUCTION, on Wednesday, June 22, 1904, at Six o'clock.

Particulars of the AUCTIONEERS, 109, King's Road, BRIGHTON, LONDON, and EASTBOURNE.

STEAM, OIL, and WATER.

Any Range of Pressure.

Price 15s., Limp Cloth,

ANALYSIS OF THE ACCOUNTS
OF THE
METROPOLITAN WATER COMPANIES

Compiled by
WOOD, DREW, & CO.,
Chartered Accountants.

WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

NEWBATTLE CANNEL.
Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO
THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

THE
PETROLEUM GAS SYNDICATE
Supply and erect Complete Installations of their
PETROGENE PATENT GAS PLANT
On SALE, HIRE, or ROYALTY.

PETROGENE GAS is the most suitable Illuminant for all Towns, Villages, Factories, Institutions, &c., where a Cheap and Efficient Lighting System is required. It is equally suitable for Heating and Power purposes, and may be used with ordinary Gas Fittings, Stoves, Engines, &c. It may also be used in conjunction with Coal Gas, and affords Gas Companies a ready means of increasing their output without the expense of additional storage.

The Syndicate is prepared to entertain offers of sale of small Gas-Works, whether profit earning or not.

Offices: **28, Victoria St., Westminster.**
Works: **10, Rochester Row, S.W.**

THOMAS DUXBURY & CO.,
16, DEANSGATE, MANCHESTER,
Gas Engineers' Agents and Contractors for
METERS, FIRE-CLAY GOODS, OXIDE OF IRON, AND ALL OTHER GAS APPARATUS.
Inquiries Solicited.
Telegrams: "DARWINIAN, MANCHESTER," Telephone 1806.

THE
"ROTARY" STATION METER.
Efficiency Demonstrated.
APPLY—
T. G. MARSH,
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MANCHESTER.

The "BRITON" and "RENNIE" Gas Arc Lamps
(COLBRAN'S PATENT).
VERY STRONG ORNAMENTAL LAMPS.

REGISTERED.
"V" PATTERN "BRITON" LAMP.

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THE CROWN LAMP WORKS,
58 & 59, CHISWELL ST., E.C.
Telephone: No. 4199 Central.

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NEWBIGGING'S HANDBOOK
FOR
GAS ENGINEERS & MANAGERS

(DEDICATED TO SIR GEORGE LIVESEY).

The Work has been revised throughout, and contains 40 pages of Letterpress and 12 Illustrations more than the last Edition.

In almost every department additions have been made; and it is believed that the labour bestowed on its production will enhance the value of the book as a Work of Reference.

Orders may be sent through any Bookseller, or direct to the Publisher, WALTER KING, Office of the "Journal of Gas Lighting," &c., 11, BOLT COURT, FLEET STREET, LONDON.

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Brettell's Estate
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Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.
Special Lumps, Tiles, and Bricks for Regenerative and Furnace Work.
SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

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Operated Entirely by One Handle
Class A lifts 24 ft.
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SEND FOR LIST.
Telegrams: "Temperature, London." Tel. No. 12,455 Central.
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JAMES OAKES & CO.,
ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road, CITY ROAD, LONDON, N.,
Manufacture and keep in Stock at their Works (also large stock in London)
PIPES and CONNECTIONS, 1½ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS, and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.
NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with Bolts, Nuts, and Covers, and rendering Leakage impossible.

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STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES, SPANNERS, RATCHET BRACES, LIFTING JACKS, ANVILS, VICES, AND ENGINEERS' TOOLS GENERALLY.
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New and Second-Hand with all Accessories; also Tip Waggons and Turntables.
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Prices and Analysis of all the Scotch Cannels on Application.

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Gas Companies are solicited to try Samples of the
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BLACK BED GAS COAL.
Prices and Analysis on application.
MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

HEATHCOTE GAS COAL.
Rich in Illuminating Power and yield of Gas.
Above the Average in Weight and Quality of Coke.
Maintains a High Standard in Residuals.
THE GRASSMOOR CO., LD.,
CHESTERFIELD.

JOHN HALL & CO.,
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Manufacturers of
FIRE-BRICKS, LUMPS, TILES,
GAS RETORTS,
And every description of Fire-Clay Goods.
RETORTS CAREFULLY PACKED FOR SHIPMENT.

THE SILICA FIRE-BRICK COMPANY,
OUGHTIBRIDGE, near SHEFFIELD,
MANUFACTURE
SILICA BLOCKS, BRICKS, AND CEMENT
OF SUPERIOR QUALITY
FOR GAS-FURNACES.
Trade Mark: "SILICA."
These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their
GREATER DURABILITY,
Strongly recommended where EXCESSIVE HEATS have to be maintained.

THE PATENT
"BEACON" GLOBE LAMP.

Largely adopted by many Local Authorities for Public Lighting, being absolutely Shadowless and Wind-proof.
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MOELLER'S BURNERS
MAINTENANCE SIMPLIFIED.
Nothing to Corrode. Nothing to Choke.
Nothing to get out of Order.
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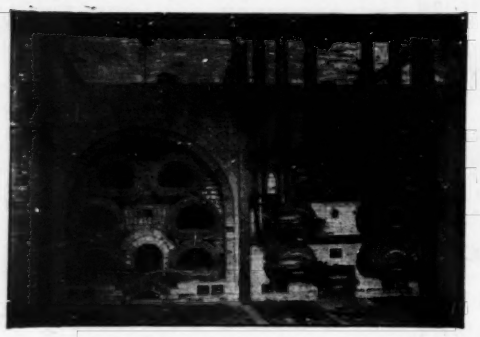

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REGENERATOR & GENERATOR SETTINGS

DEEP, SEMI-DEEP, AND SHALLOW.

Maximum Make per Ton and Mouthpiece.

Minimum Fuel Consumption.

NUMEROUS REPEAT ORDERS

Have been received for each of the above types of Settings.

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Designs and Estimates on application. **28, EAST PARADE, LEEDS.**

PATENT "STANDARD" PURIFYING GRIDS.

Orders received for **148** Purifiers.

RECENT ORDERS: Ilford Gas Company, Barnet District Gas and Water Company, and Wadhurst and Ticehurst District Gas Company.

CAPACITY OF PURIFIERS MORE LARGELY INCREASED.

Pressure and Cost of Emptying and Filling more Largely Reduced than by any other System.

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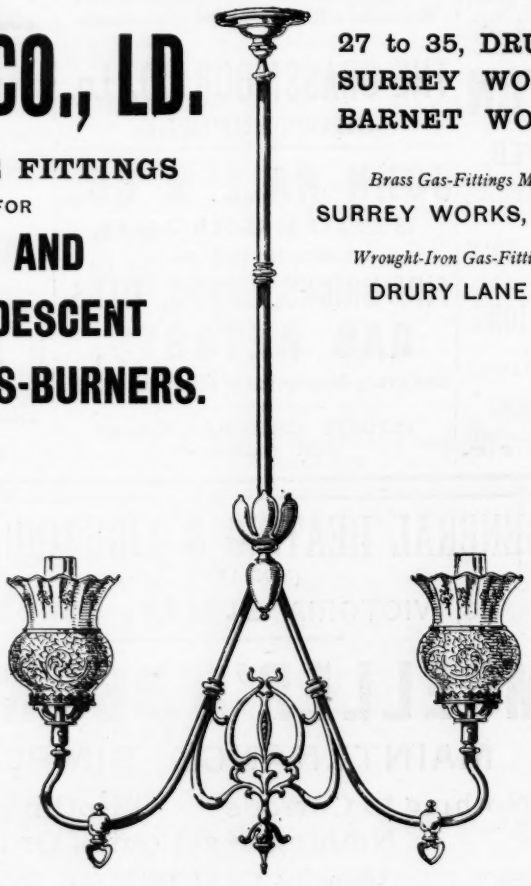

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THE WINSTANLEY SPECIALTY COY. GAS ENGINEERS

GAS ENGINEERS.

CONTRACTORS FOR, AND ERECTORS OF, ALL GAS-WORKS PLANT.

REGENERATORS, GENERATORS, AND DIRECT-FIRED RETORTS.

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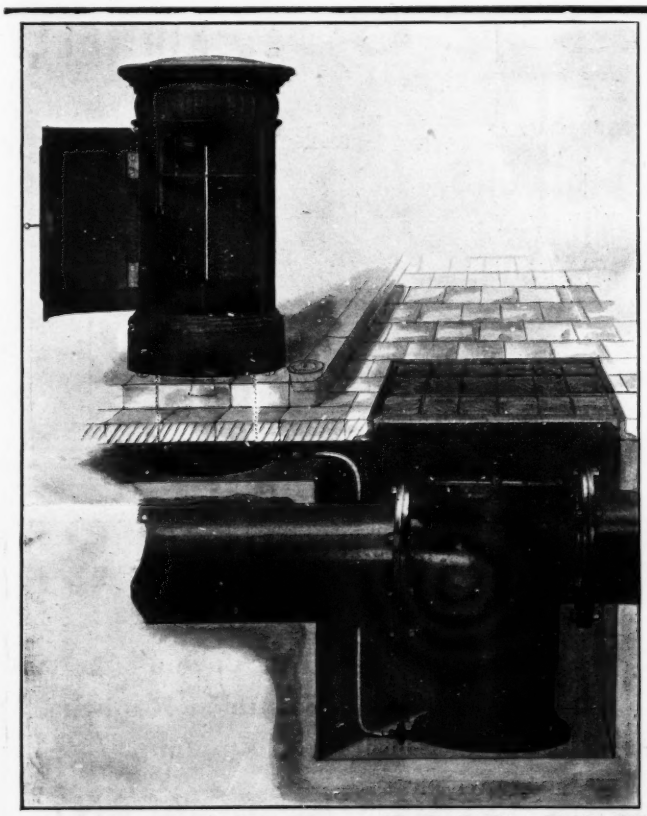
Stourbridge,

Are being entrusted with **LARGE REPEAT ORDERS** for Home and Abroad for INCLINED and HORIZONTAL RETORTS

CONSEQUENT UPON THE "A1" QUALITY THEY SUPPLY.



PATENT - - - - UNDERGROUND

GAS GOVERNOR

With Street Pillar Box.

The Governor is fitted in a chamber in the Roadway, the Regulating Air-bell in the pillar-box on the Footway. This arrangement is specially suitable for high-pressure distribution. A number of these Governors have been erected by us for inlet pressures, from 3 lbs. per sq. inch down to ordinary gasholder pressures, and these are regulating the outlet pressures to a great nicety in the local distributing mains.

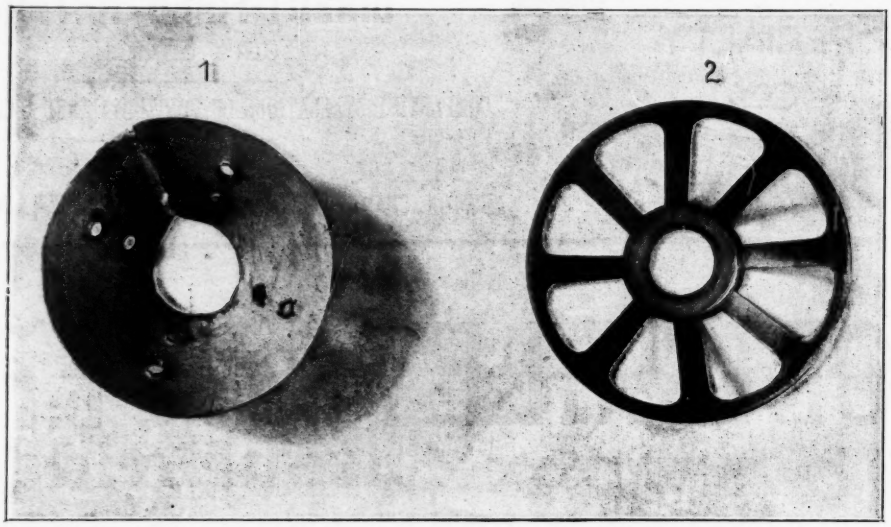
JAMES MILNE & SON, LTD.

GLASGOW.

LONDON. EDINBURGH. LEEDS.

Chap. III. **The Humors of Gas-Fitting** June 21, '04.

There is one kind of consumption that we are all anxious to encourage—I mean all *right-minded* people!—and that is gas consumption. On the other hand, it is obviously a very doubtful matter to do anything that should restrict the none too liberal use of air—even of the variety commonly served out to English town dwellers. Nevertheless, I have a suspicion—I trust I shall be unable to substantiate it—that some Gas Companies look upon the free consumption of air with a jealous eye, quite reasonably assuming that gas ought to be used instead.



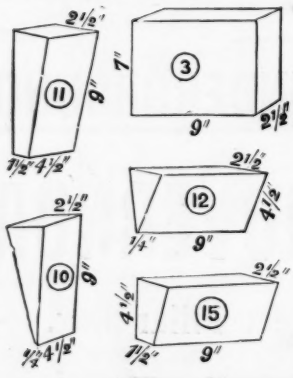
These reflections have been started in my mind by an inspection of a curious device, which will be found reproduced in the accompanying illustration (No. 1). It belongs, of course, to the museum kept by Messrs. Moffat's Ltd., 155, Farringdon Road, E.C., and which I have previously drawn upon for these small "stories from actual life." It is a suggestion for restricting the consumption of air in the Lucas Lamp, and I presume the inventor had in his mind that the depletion of air, caused by this lamp in its usual form, might mean a serious loss to the community at large, more especially as Lucas Lamps are being scattered abroad by the thousand. I do not know if he has taken into consideration that the ordinary construction of the Lucas Lamp is also unfair to Gas Companies as unduly restricting the consumption of gas.

Nor do I know if the idea has been put to a practical test, but there is the stamp of success on the face of it. Some critical reader might suggest that the jump from an ordinary Lucas Lamp cradle (reproduced in No. 2) to its improved modification by an addition of the unpatented air-regulator shown is bigger than most men of average weight and agility can undertake. But some people can never find anything good enough, and I prefer to think that the inventor of this prepossessing device knew what he was doing, when designing his instrument for effectively hindering the ingress of air into the Lucas Lamp.

(For Chapter IV., See the "*Gas World*," June 25.)

STEPHENS & CO., KIDWELLY.

Contractors to a large number of the Principal Gas-Works.



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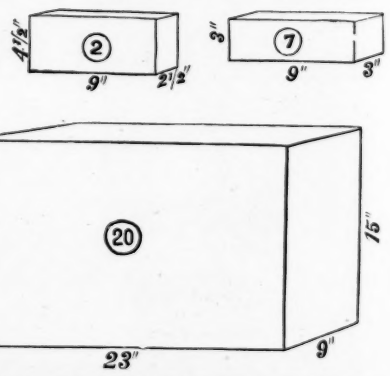
BRICKS, BLOCKS, TILES, & SHIELDS of any shape made to order.



COAL TAR PRODUCTS.

Benzol, Toluol, Solvent Naphtha, Creosote Oils, Grease Oils, Carbolic Acid, Crude Creosote Salts, Granulated (Crude) Naphthalene, Sublimed Naphthalene, Anthracene, Refined Tar, Pitch, also Sulphate of Ammonia.

For Prices apply to the **SOUTH METROPOLITAN GAS COMPANY,**

Works: ORDNANCE WHARF, EAST GREENWICH, LONDON, S.E.

709, OLD KENT ROAD, LONDON, S.E.

Telegraphic Address: "METROGAS, LONDON."

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Telegrams: "RAGOUT, LONDON." Telephone 273 CENTRAL.

METHANE-HYDROGEN WATER-GAS PLANT.

3 gallons Tar and 20 lbs. Coke produce 1000 cubic feet 10 to 12 Candle Power Gas of the following composition—

Hydrogen	64·4 per cent.
Methane	12·0 „ „
Unsaturated Hydrocarbons	3·0 „ „
Carbon Monoxide	15·0 „ „
Nitrogen and Carbon Dioxide	5·6 „ „
	100·0
Calorific Value	400 B.T.U.

See **Prof. VIVIAN B. LEWES'S** Lecture before Society of Arts, reported in the "JOURNAL OF GAS LIGHTING," Dec. 9, 1902.

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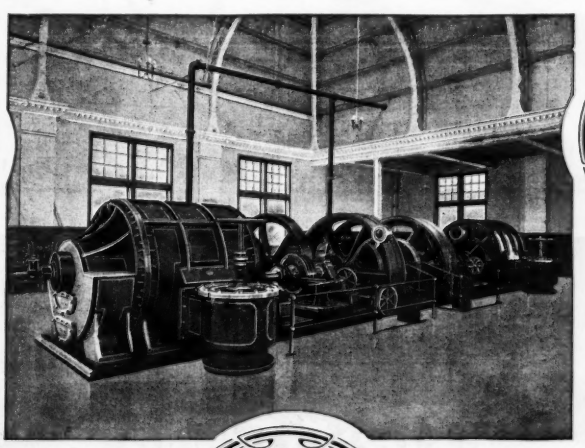
GAS & WATER ENGINEERS,



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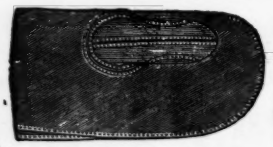
OF THE
ZURICH NEW GAS-WORKS.
By A. WEISS, Engineer of the Works.
Translated from the German for, and Reprinted from, the "JOURNAL."

London: WALTER KING, 11, Bolt Court Fleet St., E.C.

THOMAS BUGDEN, MANUFACTURER OF

TAR and LIQUOR HOSE and Special AIR TUBING.



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Made from best Tanned Leather.

India-rubber Goods of every description. Leather Bands Oils, &c., Diving and Wading Dresses, Waterproof Coats and Capes, Sewer Boots, and Theatrical Air-Proof Dresses.

Fire-Engine Hose and Appliances.

Best Materials and Workmanship Guaranteed.

Miners' Woollen Jackets (Also made in Blue Serge.) No. 1, 12/- each; No. 2, 9 6.

Gas-Bags for Mains All Seams Stitched and Taped.

116-118, GOSWELL ROAD, E.C.

SLOT GOVERNOR BURNERS

(Hawkins and Barton's Patent).

Give Excellent Results and no Trouble.

1093, 6s. per doz. 1095, 7s. per doz. 1094, 7s. per doz. 1096, 6s. per doz.

SUBJECT TO DISCOUNT.

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ARROL-FOULIS
Patent Automatic Machinery
FOR
DRAWING AND CHARGING GAS-RETORTS.

Full Particulars may be obtained from the Sole Makers.

SIR WILLIAM ARROL & CO., Limited,
GLASGOW.

[See Illustrated Advertisement, June 7, p 682.]

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